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Ocenění společnosti z automobilového sektoru za zohlednění podmínek rizika
Valuation of a Company in the Automotive Industry under the Risk Terms

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4. Estimation of the Expected Market Value of the BMW Group
5. Conclusion

Bibliography
List of Abbreviations
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Annexes

References:

HITCHNER, R. James. *Financial Valuation, Applications and Models*. New Jersey: John Wiley & Sons, 2011. ISBN 978-0470506875.
KOLLER, T., M. GOEDHART and D. WESSELS. *Valuation: Measuring and Managing the Value of Companies*. New York: McKinsey & Company Inc., 2010. ISBN 978-0470424650.
ZMEŠKAL, Zdeněk et al. *Financial Models*. Ostrava: VSB-Technical University of Ostrava, 2004. ISBN 80-248-0754-8.

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The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes, independently."

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Contents

1. Introduction

For anyone known about the field of corporate finance，understanding the valuation of a company is a necessary requisite. The aim of this thesis is to estimate the probability distribution of the market value of BMW Group at the end of year 2014 through two – stage DCF method.

There are five chapters in this thesis. The first chapter is the basic introduction of the whole thesis. In this part, we will introduce the structure of the thesis, main content of each chapter, and the aim of this thesis.

Second chapter is the theoretical part. In second part we will describe the valuation process methodologies which will be applied in practical part. First of all is the general description of company valuation, we decide to use two – stage DCF method to estimate the expected value of BMW Group. Then, common – size analysis and financial ratio analysis will be introduced and be applied in order to judge whether BMW Group has possibility to operating infinity and do prepare works for financial plan. Next is sales revenue prediction, we will introduce the ordinary least square (OLS) method to regress out the function of sales revenue and describe the standard of regression analysis. After that we will introduce Monte Carlo simulation to predict the independent variables. Then, in order to use two – stage DCF method, we should estimate the FCFF in predict years, so financial plan should also be introduced. Financial plan include plan of earnings before interest and tax, plan of net working capital, plan of investment, plan of depreciation, and plan of tax rate. What more, the methodology of calculate cost of equity, cost of debt, and weighted average cost of capital will be introduced later. By applying two – stage DCF method, the first phase is from 2015 to 2018, and the second phase is form 2019 to infinity. Last we will have a general description of sensitivity analysis.

Third chapter is focus on the introduction of BMW Group. In this chapter we will describe the basic characteristic of BMW Group, which include its main competitor, brand position and market share around the world. SWOT analysis of BMW Group will also be applied. Furthermore, we will have a comprehensive analysis of development prospect of automotive industry. And after financial analysis, according to its profitability, debt ability, and operating

activities, we can judge whether BMW Group has ability to operate infinity.

Fourth chapter is the practical part and is also the most important part for this thesis. In this part we will apply the methods and models which have been explained in the theoretical part. First of all, we will apply regression analysis to regress out the sales function. According to the feature of automotive industry we will assume some reasonable items that may influence the sales of revenue, such as CDP, CPI, personal income and so on. Secondly, we will use Monte Carlo simulation to create 10,000 random scenarios to support predict the independent variables. After that, we compute the financial plan, weighted average cost of capital to estimate the expected market value of BMW Group by two-stage DCF method. At last, we use sensitivity analysis to research the result, and make some suggestions and conclusions.

Last part is the conclusion of the thesis. In this part, we will conclude the results which we estimated at fourth part with comments.

2. Description of the Valuation Process Methodology

Chapter 2 is the theoretical part, and in this part we will introduce the valuation process methodology, which will be applied in practical part. The process of valuation will be introduced step by step.

2.1 General Description of Company Valuation

In general business valuation means through a process or a series of procedures to determine the intrinsic value of a company. Managers require a valuation to judge whether the value of a company is undervalued or overvalued in order to recommend buy or sell the company's stocks, and adjust the development strategies of the company, business planning, and future decision making. Hence, company valuation is very important to all enterprises, at same time a rational company valuation can help enterprise have a longer operating life time.

The standards of valuation include:

1. Market/ Fair value;
2. Investment value;
3. Intrinsic/ fundamental value.

Market/ Fair value

Market value also called fair value. It means Hitchner (2003, p.3), "the price at which the property would change hands between a willing buyer and a willing seller, neither being under any compulsion to buy or to sell and both having reasonable knowledge of relevant facts." In an open and competitive market, the price of goods that sellers are willing to sell and buyers are willing to buy. And both sellers and buyers without compulsion and have reasonable knowledge about relevant facts.

Investment value

Investment value means Hitchner (2003, p.5), "The value to a particular investor based on individual investment requirements and expectations." The key point of investment value is

identifies Hitchner (2003, p.5), “a particular buyer or seller and the attributes that buyer or seller brings to a transaction.” So, investment value is a kind of individual opinion and expectation of transaction participants.

Intrinsic/ Fundamental value

Intrinsic value also called fundamental value. It can be defined as Hitchner (2003, p.5), “Intrinsic value is based on fundamental analyses of companies, particularly publicly traded companies.” Or described as the true worth of an item, and based on evaluation of available of facts.

And there are 3 approaches to calculate the value of company:

1. Income approach;
2. Assets approach;
3. Market approach.

Income approach

Income approach is one of the most frequently used method to evaluate the fair value of a company. Income approach can be determined as Hitchner (2003, p.122) “a mathematical fraction consisting of a numerator and a denominator. The numerator represents the future payments of an investment, and the denominator represents the quantification of the associated risk and uncertainty of those future payments”. Income approach includes three method to evaluate the value of a company.

1. Discounted Cash flow (DCF) method
2. Economic value added (EVA) method
3. Capitalized income method.

And both three methods rely on the present value of the company’s future cash flow. The EVA method referred as Hitchner (2003, p.87), “a hybrid method combining elements of both the asset approach and the income approach.” Capitalized income method is Hitchner (2003, p.94), “a single measure of expected annual future economic benefit is used as a proxy for all future benefits.” And under the DCF method, Hitchner (2003, p.94), “discrete “expected” future economic benefits are projected for a specified number of years in the future and then a single

measure of economic benefit is selected for use into perpetuity after the specified period, which is referred to as the terminal value."

Assets approach

Assets approach can be determined as Hitchner (2003, p.232), "a general way of determining a value indication of a business, business ownership interest, or security using one or more methods based on the value of the assets net of liabilities." In other worlds, the company's value by estimating the value of it's every single assets, and mainly focus on tangible and intangible assets and liabilities of the valued company. The value of assets approach includes book value, adjusted book value, substantial value and liquidation value.

Market approach

Market approach means Hitchner (2003, p.184), "the value of a business can be determined by reference to reasonably comparable guideline companies, for which values are known." And the comparable guideline company should be public traded or sold recently, only in this way we can know the value of comparable company.

2.2 Financial Analysis

Financial analysis is a process of selecting financial data, and use mathematics method to evaluate and explain financial data. Through financial analysis we can evaluate company's operations, expenditure management, credit policy and credit worthiness, etc. The aim of financial analysis is judge whether the company has ability to operate longer. Generally, we focus on three aspects: profitability, debt paying ability and liquidity.

2.2.1 Common Size Analysis

Common-size analysis Hitchner (2003, p.86) are "once financial data has been normalized, analysts commonly employ an analytical methodology to identify operational trends—"common sizing" the financial statements." By using common-size analysis could be much easier to know the trend of the financial data, and it is more clearly to see the proportion of

different factors. Managers usually use this method to analysis the trend and find out the major differences, and compare with the whole industry, even predict the future trend of the data. There are two types of common-size analysis: horizontal common-size analysis and vertical common-size analysis.

Horizontal Common –size Analysis

Horizontal analysis is one of the most frequently used financial analysis method. Usually it applied for observe one items change during a long time period, generally we use line chart to present the changes at time horizon. Horizontal common – size analysis is a visual way to observe the items change compared with observe at table sheet.

Vertical Common-size Analysis

On the contrary, vertical common-size analysis is applied for observe more than one factors as a proportion during selected benchmarks, both balance sheet and income statement can be applied.

2.2.2 Financial Ratio Analysis

The function of financial ratio analysis is Hitchner (2003, p.90), "allow the analyst to assess and analyze the strengths and weaknesses of a given company with regard to such measures as liquidity, performance, profitability, leverage and growth, on an absolute basis and by comparison to other companies in its industry or to an industry standard." And financial ratio analysis is one of the most basic financial analysis tools. It includes four part: profitability ratios, liquidity ratios, solvency ratios and activity ratios.

Profitability Ratio

Profitability ratio is Hitchner (2003, p.82), "measure the ability of a company to generate returns for its shareholder, it also measure financial performance and management strength." Profitability ratio includes ROA, ROE and operating profit margin.

ROA is also called return on assets. We can use ROA to measure every one unit of assets can get how much net income. And from ROA we know the efficiency of the company's total

assets:

$$ROA = \frac{net\ income}{total\ assets}. \tag{2.1}$$

ROE is also called return on equity. It can be evaluate the ability of a company to generate its net income by the net assets.

$$ROE = \frac{net\ \ income}{equity}. \tag{2.2}$$

Operating profit margin is measuring the company's ability to general profit to deal with its cost of operations:

$$Operating\,profit\ margin = \frac{operating\,profit}{\text{net sales}}. \tag{2.3}$$

Liquidity Ratio

Liquidity ratios are Hitchner (2003, p.78), "measure a company's ability to meet short-term obligations with short-term assets." Generally the higher liquidity means the company has stronger ability to pay back the short-term debts.

Current Ratio is to measure whether the company's current assets can cover the short-term liabilities:

$$Current\ ratio = \frac{current\ assets}{current\ liabilities}. \tag{2.4}$$

Quick ratio focus on the most liquid assets, so it should minus inventories. It indicated how much the most liquidity assets can cover one unit of currency liabilities:

$$Quick\ ratio = \frac{current\ assets\text{-}inventories}{current\ liabilities}. \tag{2.5}$$

Solvency Ratio

Different with the liquidity ratio, solvency ratio is to measure a company's ability to deal

with its long-term liabilities. Solvency ratio is an important indicator for financial position, it can also show the ability of financing of a company. It include four types of solvency ratio: debt-to-assets ratio, debt-to-equity ratio, and so on.

Debt-to-assets ratio describe proportions of total debt to total assets, which indicate how many total assets are financed with debts. If the ratio is close to 1, means most of the assets are funded by liabilities rather equities, so the company may have the risk of default in the future. The equation of debt – assets ratio is:

$$Debt\ to\ assets\ ratio = \frac{total\ debt}{total\ assets}. \tag{2.6}$$

Debt-to-equity ratio is to measure relationship between equity and debt. It can treat as a signal to indicate how many liabilities that the company has risk to default. The small result means the company has small pressure for its long – term liabilities.

$$Debt\ to\ equity\ ratio = \frac{total\ debt}{equity}. \tag{2.7}$$

Activity Ratio

Activity ratio can be described as Hitchner (2003, p.79), “an efficiency ratios provide an indication as to how efficiently the company is using its assets.”

Inventory turnover is the cost of goods sold divided by inventories. It can reflect the efficiency of inventory turnover:

$$Inventory\ turnover = \frac{cost\ of\ goods\ sold}{invetory}. \tag{2.8}$$

Total assets turnover is the ratio between total revenues and total assets in a specified period. Total assets turnover can evaluate the management quality of a company’s total assets. The faster the total assets turnover rate, reflect the stronger sales ability of a company.

$$Total\ assets\ turnover = \frac{total\ revenue}{total\ assets}. \tag{2.9}$$

2.3 Sales Revenue Prediction

For sales revenue prediction, we need to regress out the sales function in order to predict the future sales revenue. Then use Monte Carlo simulation and create scenarios of random numbers to evaluate the independent variables.

2.3.1 Sales Revenue Regression

We can use ordinary least square (OLS) method to regress out the function for dependent variables. At first we can find historical data about dependent variables in income statement. Then, we need to find some independent variables that may have influence on dependent variable. The independent variables can be macro-economic index, such as GDP, CPI, inflation rate or costs of raw materials associate with the specific industry. Monahan (2001, p.428), "The regression function can be expressed as:"

$$y = \beta_0 + \beta_1 \cdot x_i + \mu \,. \tag{2.10}$$

From equation (2.10) we can state that y is dependent variables, and x_i is independent variables. And β_0 is intercept parameter, β_1 is slope parameter, μ is random error term or residuals. The variable x can vary with different items. And if x and y are positively correlated, the slop will be positive, if x and y are negative correlated, the slop will be negative.

Calculus for solving the minimization problem of the two parameters we obtain the following first order conditions:

$$\sum_{i=1}^{n} (y_1 - \hat{\beta}_0 - \hat{\beta}_1 \cdot x_1) = 0, \tag{2.11}$$

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2}, \tag{2.12}$$

$$\bar{y} = \hat{\beta}_0 + \hat{\beta}_1 \bar{x}. \tag{2.13}$$

In formula (2.13), $\bar{y}$ and $\bar{x}$ is the mathematic average of sample dependent variables and independent variables.

Then, we can use EXCEL to finish regression analysis and figure out the final regression function. But not all the factors we assumed have significant influence on dependent variables, so there are some indicators we should pay attention when we regress the function:

R-square: R^2 is called the coefficient of determination. It computes the fraction of variations in y explained by the model. And shows how much our model explains the changes in the dependent variable, by using independent variables. So, the bigger R-square indicate a better situation of regression.

P-value: P-value helps us to determine the significance of the result. Usually we give the significant level 5%. Usually the value of p-value should between 0 and 1, and we judge in following way:

- P-value smaller than 5%, means a strong evidence against the null hypothesis, we reject the null hypothesis. So, the regression result is statistical significant.
- P-value bigger than 5%, means a weak evidence against the null hypothesis, we do not reject the null hypothesis, accept it. And the regression result is not statistical significant.

According to these standards we can judge whether the regression result is acceptable or not. After getting the final regression function, based on β_1 coefficient we can know the relationship between dependent variables. According to β_0 we can see that if the independent variables are equal to zero, the revenue of the company is just equal to β_0.

And then we should check the independent variables' correlations of logarithmic returns. If the correlation is high, we have to use Cholesky decomposition to give the same correlations when simulating the random number. But if the correlation between logarithmic return is very small, so we don't need to fix the correlation of random variables

2.3.2 Monte Carlo Simulation

For estimating free cash flow. First of all we use excel to create random number by Monte Carlo simulation, and all generated numbers obey the normal distribution. The steps in excel to generate random numbers are as follow: Data → Data Analysis → Random Number Generation. And choice the mean equal to 0, standard deviation equal to 1."

And then we should check the correlation between independent variables. So, we should calculate expected logarithmic return. The formula is:

$$R(i) = ln\frac{S_t}{S_{t-1}}. \tag{2.14}$$

In formula (2.14), $R(i)$ is the expected logarithmic return for i, and S_t is the value of i at time t. And we need to fix the random variables in order to respect the random variables by using Cholesky decomposition if the correlation between the logarithmic return is high. According to Cholesky decomposition the equation for each scenario is:

$$\vec{Z}^T = \vec{e}^T \cdot P. \tag{2.15}$$

In formula (2.15), $\vec{e}^T$ is the vector of independent random variables and P is the upper triangular matrix.

Since we already created random numbers generated by Monte Carlo simulation, so the next step is to calculate upper triangular matrix p. Zmeskal (2004, p.119), "The equation to calculate upper triangular matrix p are as follow":

$$P_{ii} = (\sigma_{ii} - \sum_{k=1}^{i-1} p^2 ki)^{\frac{1}{2}},\ for\ i = 1,2,3\ldots N, \tag{2.16}$$

$$P_{ij} = (\sigma_{ij} - \sum_{k=1}^{i-1} p_{ki} \cdot p_{kj}) \cdot p_{ii}^{-1},\ for\ 1 \le i \le j \le N, \tag{2.17}$$

$$P_{ij} = 0. \quad for\ i \geq j\ . \tag{2.18}$$

Where in formula above, σ is the standard deviation, ρ is the value in upper triangular matrix. Then we can continue to evaluate the independent variables in future five years with some other indictors:

$$\mu = ln\frac{S_t}{S_{t-1}}, \tag{2.19}$$

$$\alpha = \mu - \frac{\alpha^2}{2}. \tag{2.20}$$

From formula (2.19) and (2.20), μ is the continuous logarithmic return, σ is the standard deviation of continuous return. Then the following step is to calculate the random evolution of independent variables as follow:

$$S_t = S_{t-1} \cdot exp(\alpha \cdot \Delta t + \sigma \cdot \widetilde{Z} \cdot \sqrt{\Delta t}). \tag{2.21}$$

Here, $\widetilde{Z}$ is a random value from the standard normal distribution N (0; 1) and σ is the standard deviation from the continuous logarithmic returns.

Then Vasicek model will also be applied to predict independent variables. Zmeskal (2004, p.119) states "Vasicek model belongs to mean-reverting models and respects an empirical fact. The disadvantage is that it allows the result could be negative". The equation of Vasicek model is like:

$$r_t = r_{t-1} + a(b - r_{t-1}) \cdot \Delta t + \sigma \cdot \widetilde{Z} \cdot \sqrt{\Delta t}. \tag{2.22}$$

Where in formula (2.22), b is long-run mean, a represent velocity. $\widetilde{Z}$ is a random value from the standard normal distribution N (0; 1). With all steps finished, we can get the result of predict independent variables, then put all the results into the regression function we can get the final result of sales revenue.

2.4 Financial Plan

Zmeskal (2004, p.18) states "Financial plan is a key instrument of company management. It helps the managers to combine sources and activities, it defines parameters for managing the systems, it represent clear and discrepancy-free description of resources and expectations of the company, and it facilitates assessment of managers and profit units." Financial include plan of earnings before interest and tax, plan of net working capital, plan of tax rate, plan of investment, and plan of depreciation. After the process of financial plan we can get the result of free cash flow. The equation of FCF is:

$$FCF = EBIT \cdot (1 - t) + DEP - \Delta NWC - INV \tag{2.23}$$

In formula (2.23), FCF represents free cash flow, EBIT represents earnings before interest and tax, t is tax rate, DEP represents depreciation, NWC represents net working capital, and INV stands for investment.

Plan of Earning Before Interest and Tax

As we all know, earnings before interest and tax (EBIT) has a close relationship to company's revenue, so we can utilize the relationship between EBIT and sales revenue, which is referred as operating margin (OM) to evaluate the EBIT in predict years:

$$Operating\,margin = \frac{EBIT}{sales}. \tag{2.24}$$

We can get the historical data of EBIT and sales revenue at income statement, then according to formula (2.24) we can come put the operating margin. Since the operating margin is different from year to year, so we should give the different weighted to different years according to the importance of specific year. Then use the weighted average operating margin as the final result. Besides we already predict the sales revenue in future five years with 10000 scenarios, so it is easy to get the result of EBIT in future five years with 10000 scenarios. The method to calculate weighted average operating margin are as following:

$$k = \sum_{i=1}^{t} k_i \cdot w_i \,, \tag{2.25}$$

$$\sum_{i=1}^{t} w_i = 1 . \tag{2.26}$$

From formula (2.25) and (2.26), k is the weighted average operating margin, k_i is the operating margin at time i, and w_i is given weighted at time i. And the sum of given weighted should equal to 1. The use the weighted average operating margin times every predicted sales revenue is the estimated EBIT.

Plan of Net Working Capital

Net working capital is the full name of NWC. It means the differences between current assets and current liabilities. So we can start from prediction of current assets and current liabilities. First of all we can calculate ratio of current assets and revenues

$$r = \frac{Current\ assets}{Revenue} \tag{2.27}$$

In formula (2.27), r is the ratio of current assets and revenues. And we can calculate the ratio of current liabilities and revenues with the same way. After getting the result of current assets divide revenues and current liabilities divide revenues, then we can use the weighted average method to sum up the final result of ratio. Since we already predicted the 10000 scenarios of revenue in predict years so we can get the result of 10000 scenarios of current assets and current liabilities. Automatically, the differences between future current assets and current liabilities is the net working capital we need to predict.

Plan of Investment

Investment is associate with the development and expand of a company and we can find investment from balance sheet. For plan of investment it is necessary to take into account the capacity due to planned sales growth and company's historical investment. Besides the

investment can't be lower than depreciation. On the other, the company's particular investment plans should also take into consideration.

Plan of Depreciation

Depreciation means during the estimated useful life time the gradual cost of fixed assets in an operational expense. So when we predict the depreciation in the future we will use the ratio of depreciation divide fixed assets. We can use excel to find the equation to express the develop trend of fixed assets, to calculate the amount of fixed assets in future five years. Then use the fixed assets we predicted times the ratio, we can get the amount of depreciation in future five years.

2.5 Two-Stage Discounted cash flow method

Discounted cash flow method also called DCF method, Hitchner (2003, p.87) state "DCF method depends on present value of an enterprise's future cash flows, often based on historical financial data." Two – stage DCF method divide the valuation period into two stage, the first stage assume we have the precisely FCF and for the second phase the company will gain constant FCF or gain cash flow with constant growth rate to infinity. And the equation for two – stage DCF method is:

$$V = \sum_{t=1}^{T} \frac{FCF_t}{(1+R_1)^2} + \frac{FCF_{T+1}}{R_2 - g} \cdot (1+R_1)^{-T}, \tag{2.28}$$

In formula (2.28) R_1 is the cost of capital in the first phase which is the short-run of the company, R_2 is the cost of capital in the second phase which is the long-run of the company, T is the length of the first phase, and g is the growth rate of the company. Since we already predict the FCF in the steps above, so we can use the increase rate of FCF in last two predict years as g. Then we just need to continue estimate the weighted average cost of capital in two stages.

2.6 Weighted Average Cost of Capital

Weighted average cost of capital can be defined, Hitchner (2003, p.17), as "the cost of capital (discount rate) determined by the weighted average, at market value, of the cost of all financing sources in the business enterprise's capital structure". From company point of view the weighted average cost of capital (WACC) is the minim required rate of return.

The source of capital included in WACC calculation, such as common stock, preferred stock, bonds and any other long-term debt. The cost of equity and cost of debt are main component to calculate WACC. So, when calculate WACC, multiply cost of equity and cost of capital by its proportional weight and take the sum of the results. The method for calculating WACC can be expressed in the following formula:

$$WACC = R_E \cdot \frac{E}{A} + R_D \cdot (1-t) \cdot \frac{D}{A}. \tag{2.29}$$

In formula (2.29), R_E is the cost of equity, R_D is the cost of debt, E is the value of firm's equity, D represents the value of firm's debt, and A represents the total assets of a company. We can find equity, debt and total assets in balance sheet, so the next step is to calculate cost of equity and cost of debt.

2.6.1 Cost of Equity

Cost of equity referred as the expected rate of return of company's stock. And we usually through capital assets price model (CAPM) to estimate the cost of equity. Goedhart (2010, p.238), "a stock's risk as its sensitivity to the stock market." The formula of CAPM is:

$$E(R_E) = R_f + \beta_t \cdot \left[E(R_m) - R_f\right]. \tag{2.30}$$

Where in equation (2.30), $E(R_E)$ is the expected return of equity, R_f represents the risk free rate, β_t is the stock's sensitivity of the market, $E(R_m)$ is the expected return of market and $\left[E(R_m) - R_f\right]$ is the market risk premium.

Generally, we use the yield of government long-term bond as risk free rate, this is because there is no default risk for government bond. And for two – stage DCF method we use two different risk-free rate, because of the short-term and long-term maturity, the liquidity and risk of default is different. Long-term investment should have lower liquidity, with higher default risk, so the long-term risk-free bond usually have higher return rate.

According to CAPM, a stock's expected return is driven by β coefficient, which measures how much the stock and market move together. We can find unlevered of specific industry on the agency website Damodaran. And then according to formula below to calculate the levered β coefficient:

$$\beta^L = \beta^U \left[1 + (1-t) \cdot \frac{D}{E} \right]. \tag{2.31}$$

Where in formula (2.31), β^L represents the levered β coefficient, β^U represents the unlevered β, and t is tax rate. The unlevered β means the β of a firm without any debt.

Risk premium means expected return of market minus risk free rate. And in CAPM the risk premium referred to the market risk premium and belongs to systematic risk. We can find the risk premium of specific market on Damodaran online.

2.6.2 Cost of Debt

When a company has liquidity problem, companies usually try to use debt financing, such as loans, bonds, and other kinds of securities. So, the cost of debt is interest payment of the long-term financing borrowing of a company. Usually there are two ways to measure the cost of debt.

The first situation is for profitable companies, and refers to the cost after tax. In this situation companies to solve the liquidity problem by loans form bank. The equation can be expressed as:

$$R_D = \frac{Annual\ interest}{Market\ value\ of\ debt}. \tag{2.32}$$

And to estimate the cost of debt for investment companies, we can use the company's long-term yield to maturity. If the company is bonds issuer, we can use the yield to maturity (YTM) of the company's long-term bonds as cost of capital of. The formula can be expressed as:

$$Bond\ price = \frac{coupon}{1+YTM} + \frac{coupon}{(1+YTM)^2} + \cdots + \frac{coupon + face\ value}{(1+YTM)^n}. \tag{2.33}$$

In formula (2.33) coupon is the amount of dividends bond holder can get according to the contract. YTM represents the yield to maturity, which means the return on a bond if the bond held to maturity.

2.6.3 Sensitivity Analysis

Saltellieti (2004, p.1) state, "The study of how uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input." Sensitivity analysis is to figure out if change of independent variables how the dependent variable will change responsible. Sensitivity analysis helps to predict the outcome of the decision, if the final situation is different.

And to use sensitivity it must identify what is "model" in your sensitivity analysis, it may numerical or "input" and "output". The change of "input" will influence the result of the "output".

3. Basic Characteristic of BMW Group

In this chapter, we will describe the basic characteristic of BMW Group. First of all we will introduce some basic information about BMW Group, and the SWOT analysis method will also be applied to BWM Group. What's more, the whole auto industry should also be analyzed, in order to have a better assess on BWM Group's market share and position. Last but not the least, we will use financial analysis to search BMW Group's financial statement, which include common size analysis and financial ratio analysis.

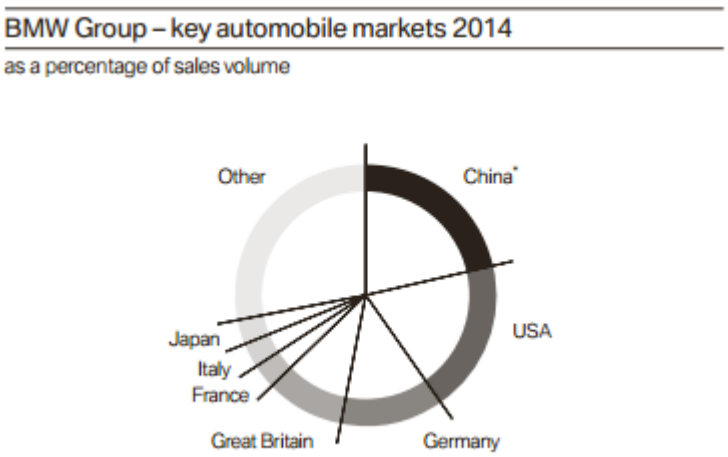
3.1 Overview of BMW Group

BMW headquartered in Munich, Germany, and the full name of BMW is Bavarian Motor Works. What's more BMW is one of the world's most respected car manufacturer and also provide premium financial and mobility service. Products for BMW are famous for its high performance and luxury. And BMW Group includes three main products, which are BMW, BMW Mini Cooper, and Rolls-Royce. And BMW are included BMW I and BMW M.

As a multinational corporation, according to the latest statistic data BMW GROUP operates almost 30 productions and assembly facilities in 14 countries and has a global sales network in more than 140 countries[1]. So it has a strong market position and also successfully in financial services arears. The main market for BMW is China, USA, Germany, and Great Britain. And in recent years, BMW Group also started to focus on the market in developing countries, the market share in China was increasing year by year. From Figure3.1 we can see the main automobile market 2014 of BMW GROUP. Take 2014 for example, percentage of sales volume in China is 21.6%, ranking first. The second one is USA, 18.7%, and the third one is Germany, 12.9%.

[1] Financial Annual report 2014.

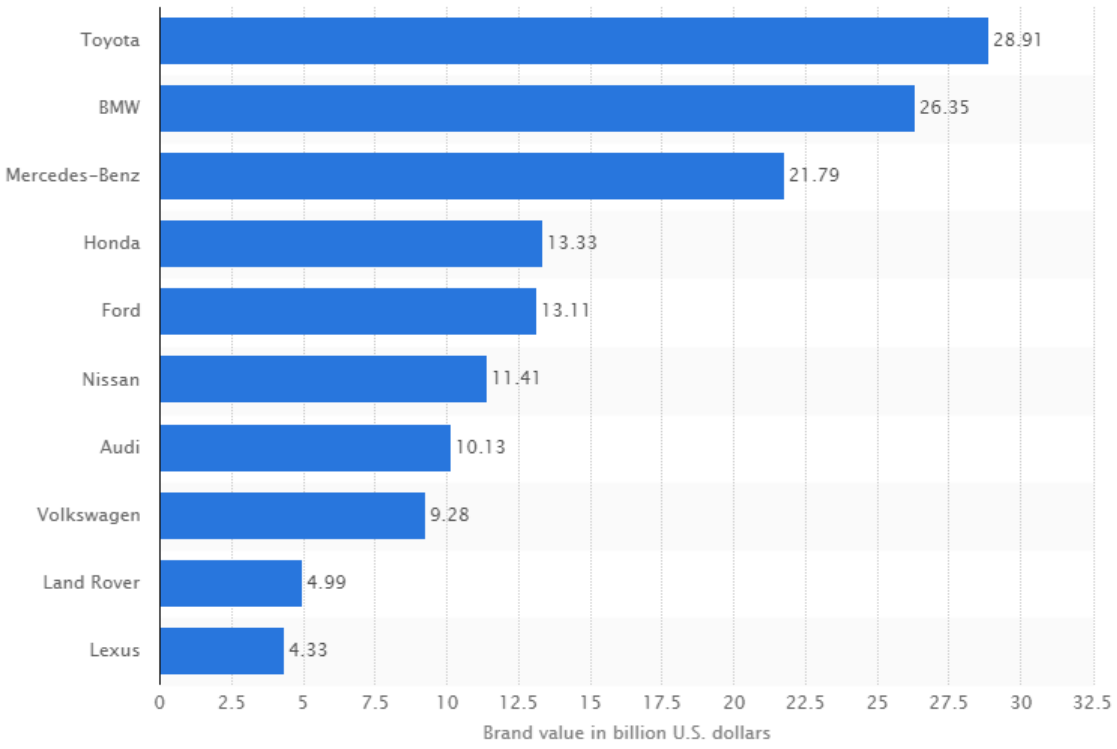
Figure 3.1



Source: Financial annual report 2014

And the main competitors of BMW Group includes Toyota, Mercedes-Benz, Honda and so on. According to Statistics Portal[2], BMW rank the second place as the most valuable brands within the automotive industry. And Toyota marque was rank first.

Figure 3.2 Ranking of valuable brands within automotive industry



[2]Most valuable brands within the automotive sector worldwide as of May 2015, by brand value

The reason why BMW can get success and has an excellent performance in automotive industry, which owe to the group always been based on long-term thinking and responsible actions.

3.2 SWOT Analysis of BMW Group

SWOT analysis plays a very important role in company and industry analysis, and pays attention to both internal and external, which include: strength, weakness, opportunity and threats. Managers according to these four part analysis to adjust their strategies and achieve their goals.

Strength

BMW Group is the leader of luxury car segment, in other word BWM stands for the good quality and excellent reputation. On the other hand, another strength is the continuous innovation and technological advancement. In the past decade the continuous improvement and innovation promote the upgrading of products, which support BMW plays an important role in auto industry. Out of the good quality of product, the customer service and after-sale service is satisfied with its loyal customers. At the end of 2014, the Group's production network comprised a total of 30 locations in 14 countries[3].

Weakness

One of the weakness for BMW is the high price, luxury car requires the best quality materials, advanced equipment and high educated employees, all results a higher car price. In that case it would influence customer behaviors.

And in 2012 the event of car recall has a big influence on BMW Group. BMW recalled 350800 vehicles around world, including 5800 production Rolls-Royce in the UK. BMW says the reason is that there exist some problems in the brake system. The consequence of this situation also has influence the sales of next year.

[3] Financial annual report 2014.

Opportunities

With the development of science and technology, more and more people relies the importance of environment, so the environment friendly car becomes more and more popular. 2014 was the first year of availability for the pure electric BMW i3. More than 16,000 customers chose this model, which was specially designed for urban arears. What's more BMW i8, has been available to customer since summer 2014.[4] In electric car arear, BMW has absolute advantages and has a leadership position among the market. So, BMW can take advantages of this opportunities and have a bright future.

On the other hand, BMW Group should increase the diversities of products, to meet the needs of different customers. And pay more attention on Asia market, Latin market and developing countries.

Threats

Auto industry always exist intense competition. Mercedes Benz, VOLVO, Cadillac and so on are all BMW's competitor. And now days, competition means more than price but also include technology, after-sale service, brand reputation, experience feelings and so on. All these factors would made customers change their choice.

Fuel problems is an opportunities for BMW Group but is also a threats for the whole auto industry. BMW are required pander to the need of green fuel and green machines, so that it can attract potential customers, especially young customers and environmentalist.

Fluctuant exchange rate also influence the revenues for BMW Group, because BMW is a multination company, and part of its profit from outside the Euro zone. Too high or too low euro exchange rate has a big influence on its revenues.

3.3 Automotive Industry Analysis

Car has already become necessities of life in developed countries, and with the development of economy in developing countries, the potential car purchasing power was

[4] Financial annual report 2014.

stimulated. The automotive industry around the world has been experiencing a strong profitability and growth rate.

The global sales of passenger cars are forecast to hit 73.9 million vehicle in 2015[5]. China, the United States and European regions are still the three biggest market for automotive industry. And the main challenge is that the global automotive market is uneven, Latin American and Africa still exist huge purchase power potential. And all the auto firms think it is a big cake for automotive industry, at same time trying to use kinds of promotion strategies to occupy the market share as much as possible.

Be differ from the traditional automobile consumption, young customers pay more attention to appearance and comfort. More and more automotive companies design new car for young people and produce cars more adaptive for urban city, such as Smart, and city SUV. Furthermore, many car firms also provide more reasonable financial plan for purchase a car. A series of examples indicated that the position of before and after sell services are more important than before.

At the same time, the energy crisis and aware of the importance of environment provides severe challenge to the automotive industry. Automotive industry is seeking energy transformation. The cost of electronics and software content in autos was less than 20 percent of the total cost a decade ago, but today it is as much as 35 percent[6]. Many automotive companies such as TOYOTA, BMW, HONDA, and VOLKSWAGEN, are trying to create pure electric car or hybrid electric vehicle. But the infrastructure construction to support the electric cars is incomplete, like charging station branches. And automotive companies also need to overcome the difficulties of battery life for the car. In order to overcome a series of difficulties, requires cooperation between companies and cooperation between the company and the government supporting.

3.4 Financial Analysis of BMW Group

According to the financial analysis of BMW Group, we can get the basic financial condition

[5] Statistics and Facts about the Global Automotive Industry
[6] 2015 Auto Industry Trends

of the company, and judge whether it has ability to operate longer. First of all, we use the historical data from 2005 to 2014 to make a common size analysis and financial ratio analysis.

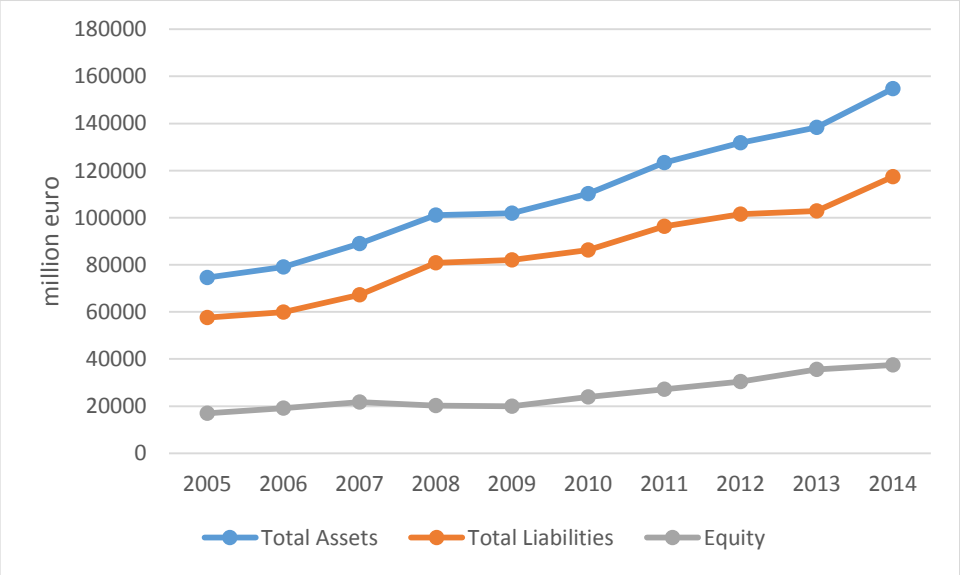
3.4.1 Common Size Analysis.

As for the common size analysis we will have a general look at BMW's financial statement from 2005 to 2014, which include balance sheet, income statement, and cash flow statement. Using the horizontal analysis to observe the trend of important items

General Situation of Balance Sheet from 2005 to 2014

In this part we will analysis the tendency of the main components of the balance sheet from 2005 to 2014, and explain the reason causing it.

Figure 3.3 Important items about balance sheet



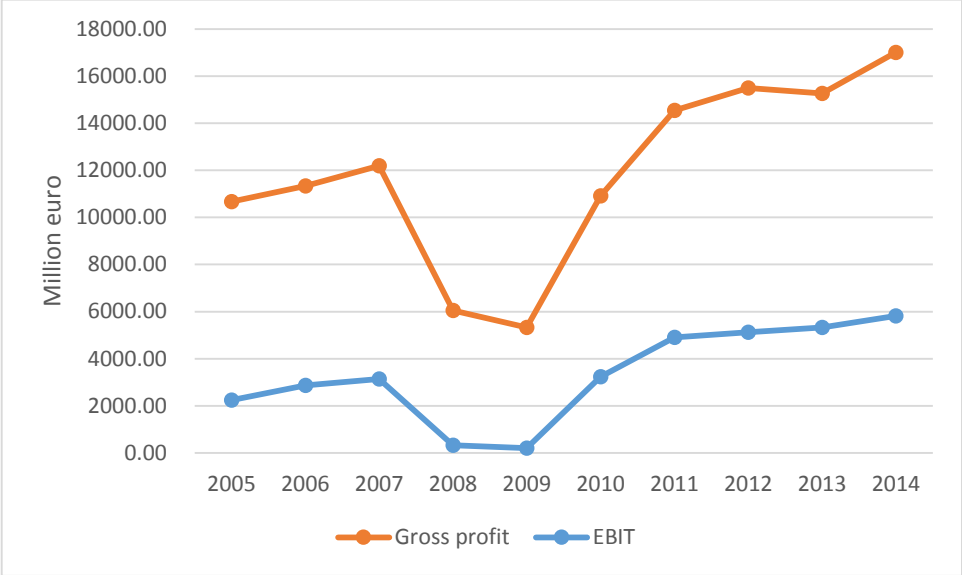
From the Figure 3.3 we can see that both total assets, total liabilities and equity kept the trend of increase. In the past decade the average increase speed of total assets is around 8.5%, which is a satisfied signal. But at the same time, the total liabilities kept the similar trend with total assets，this is due to the combination of increased capital expenditure, strategic investment . And the number of equity is relatively stable compared with total assets and total liabilities. We can get a concluded that the increase of the total assets are mainly depend on the increase of

total liabilities.

General Situation of Income Statement from 2005 to 2014

Information about income statement will focus on the operating activities, and BMW's business condition from 2005 to 2014 such as, revenues, net income and costs will be known.

Figure 3.4 Important items about income statement



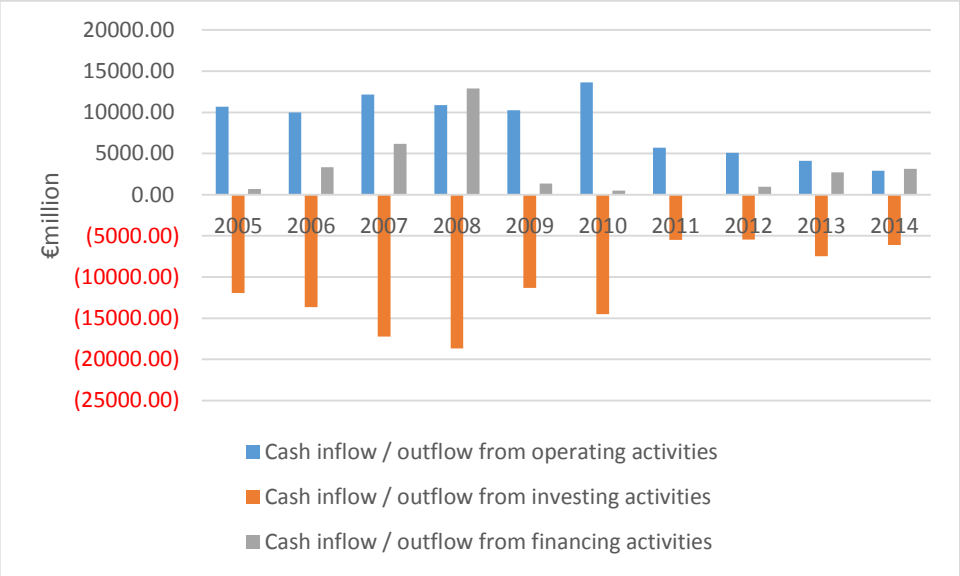
From Figure 3.4 it is clear to see that, the gross profit and *EAT* was go up and down from 2005 to 2014. The lowest point was at 2008 and 2009, this is due the global financial crisis 2008, and during this period the GDP in Germany decreased 0.056%, so the power of consumption also decreased which directly reduce the big recession for sales of whole automotive industry, and definitely include BMW Group. With the recovery of economic, the gross profit also increased a lot. The slight decrease in 2012 is due to the event of car recall. From 2012 to 2013 BMW recalled 350800 vehicles around world, including 5800 production Rolls-Royce in the UK. BMW says the reason is that there exist some problems in the brake system. The consequence of this event is the decrease of gross profit in 2013.

The net profit has the same trend with gross profit, which indicated that the costs for BMW is relatively stable with sales and the amount of productions.

General Situation of Cash Flow Statement from 2005 to 2014

From cash flow statement from 2005 to 2014 we can learn the main activities of BMW, which include cash inflow and outflow of financial conditions, investment conditions and operating conditions.

Figure 3.5 Important items of cash flow statement



From Figure 3.5 we can conclude that, cash inflow from operating activities always positive, this means the company's revenues is always more than its expenses, company is always get profits. But cash inflow from operating activities had a trend of decrease after 2010, from 2010 to 2011 cash inflow from operating activities decreased €4,476 million as a result of this reclassification[7].

Net cash outflows from investing activities in 2011 is amounted to €5,499 million and was €309 million higher than the previous year. This is due to the net change in marketable securities in a €1,169 million reduction in cash outflows for investing activities. And in 2011 BMW Group acquired the ICL Group is around €595 million[8].

The top point for financial activities is 2008, this is because cash inflows from the issue of bonds increased €3,921 million compared with 2007， while the repay of bond is totaled €5,080

[7] Financial Annual Report 2011.
[8] Financial Annual Report 2011.

million compared €4,152 million decreased €928 million[9]. By contrast, from 2008 to 2009 cash inflow from financing activities decreased €11,558 million. The reason is due to in 2009 cash inflows from the issue of bonds decreased €233 million compared with 2008， and repay of bonds increased €1,360 million. Besides[10]， because of the maturity of other financial liabilities and commercial paper, so cash outflow for other financial liabilities and commercial paper was totaled €1,562 million, compared with 2008 it increased €7,479 million.

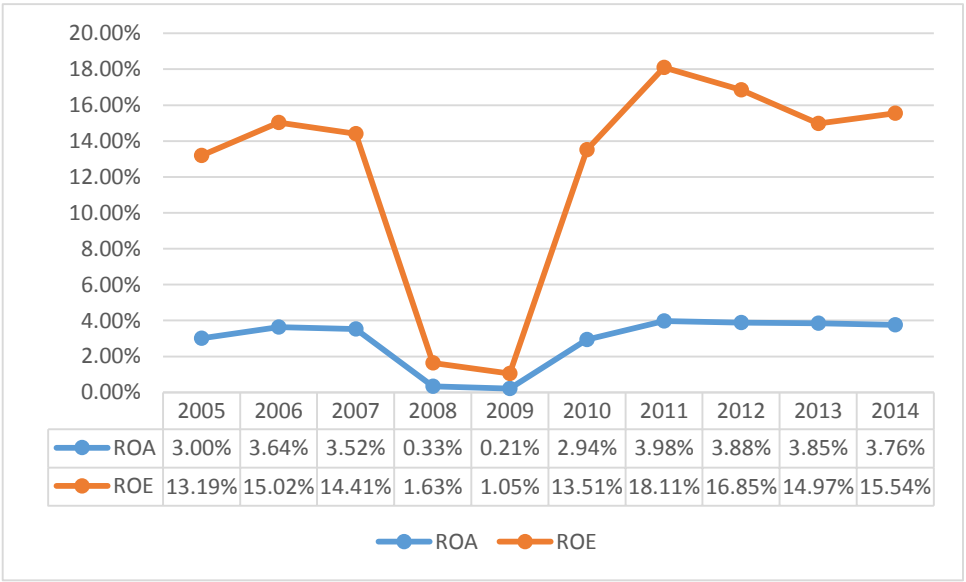
3.4.2 Financial Ratio Analysis of BMW Group

In this part we will utilize profitability ratio, liquidity ratio, solvency ratio and activities ratio to have a comprehensive analysis for BMW Group's business condition form 2005 to 2014. Through this part we can judge whether the BMW Group has ability to operating longer time.

Profitability Ratio

As for profitability ratio we will use equation (2.1) to calculate ROA and equation (2.2) to calculate ROE to measure the profitability of BMW Group.

Figure 3.6 Profitability Ratio



From figure 3.6 it is obviously to see that from 2008 to 2009 both *ROA* and *ROE* tumble to

[9] Financial annual report 2008.
[10] Financial annual report 2009.

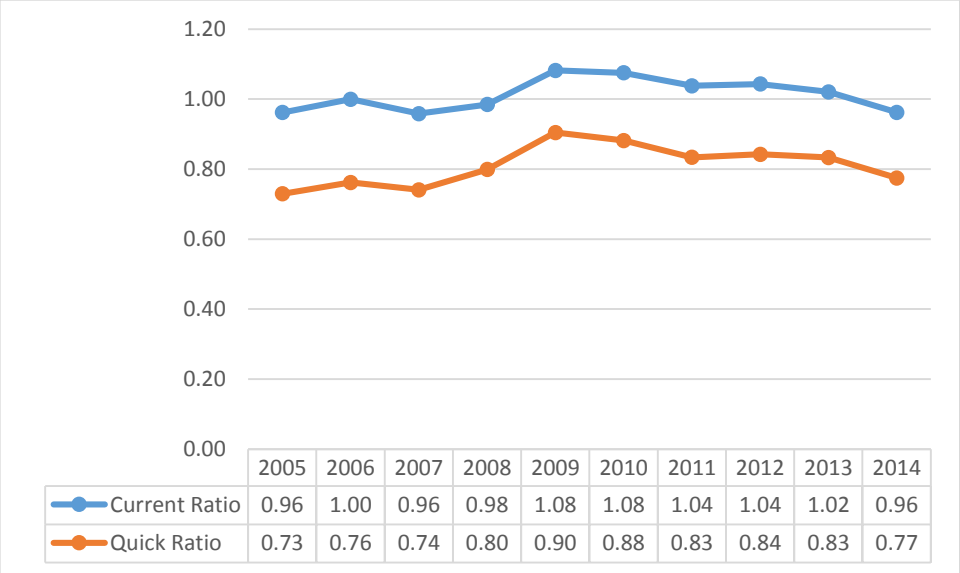
its lowest level, and after this period *ROA* and *ROE* return to the normal level. This is because of the global financial crisis in 2008, which result the consumption depressed around the world. So during this period the whole automotive industry is in bad shape.

The normal level of ROE for the automotive industry is around 14.7%[11]. Except 2008 and 2009 BMW Group kept its ROE at an industry level. Which indicate BMW Group has an excellent profitability by revealing its net profit with the equity.

Liquidity Ratio

We will use equation (2.4) to calculate current ratio and equation (2.5) to calculate quick ratio to measure BMW's ability to cover its current liabilities.

Figure 3.7 Liquidity Ratio



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Current Ratio	0.96	1.00	0.96	0.98	1.08	1.08	1.04	1.04	1.02	0.96
Quick Ratio	0.73	0.76	0.74	0.80	0.90	0.88	0.83	0.84	0.83	0.77

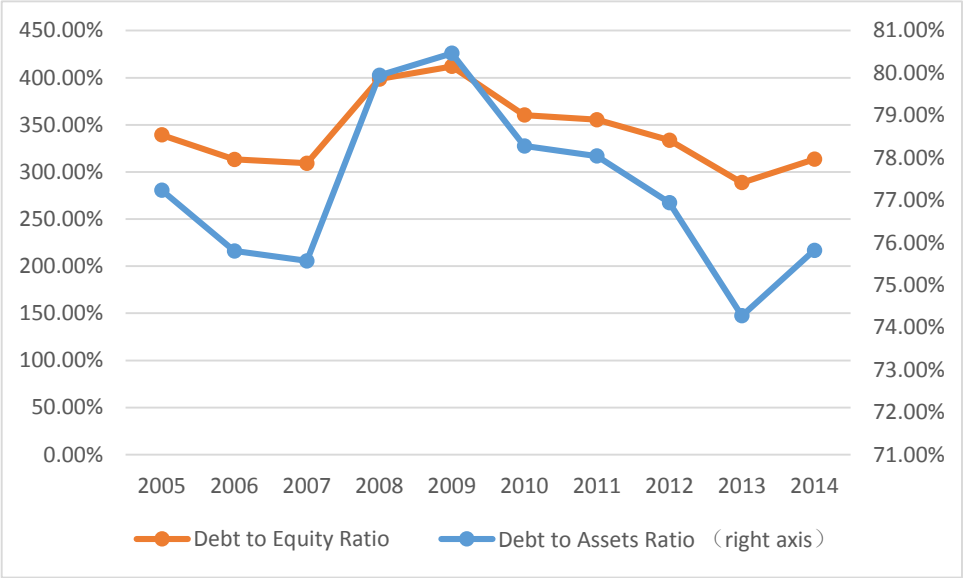
The current ratio and quick ratio is relatively stable from 2005 to 2014, which indicated that the ability to cover the current liabilities is very stable. And current ratio is around 1, we can state that BMW has no problem to deal with its liquidity issue. In other word, there is no default risk for current liabilities.

[11] Damodaran, return on equity by sector.

Solvency Ratio

To measure the ability of solvency, we can through equation (2.6) to calculate debt to assets ratio, and equation (2.7) to calculate debt to equity ratio. And by comparing with the industry average level, we can figure out the ability to deal with its long-term debts.

Figure 3.8 Solvency Ratio



From Figure 3.8 we can state that, the top point of debt to equity ratio and debt to assets ratio exist in 2009. And the debt to equity ratio is more stable than debt to assets ratio, and round 3.5, which indicated that the amount of debt is more than equity. The average debt to equity ratio for major automakers factory is approximately 2.5[12], so BMW Group is much higher than the industry level, means there exist a possible to default. On the other hand, we can treat it as a strong ability of financing.

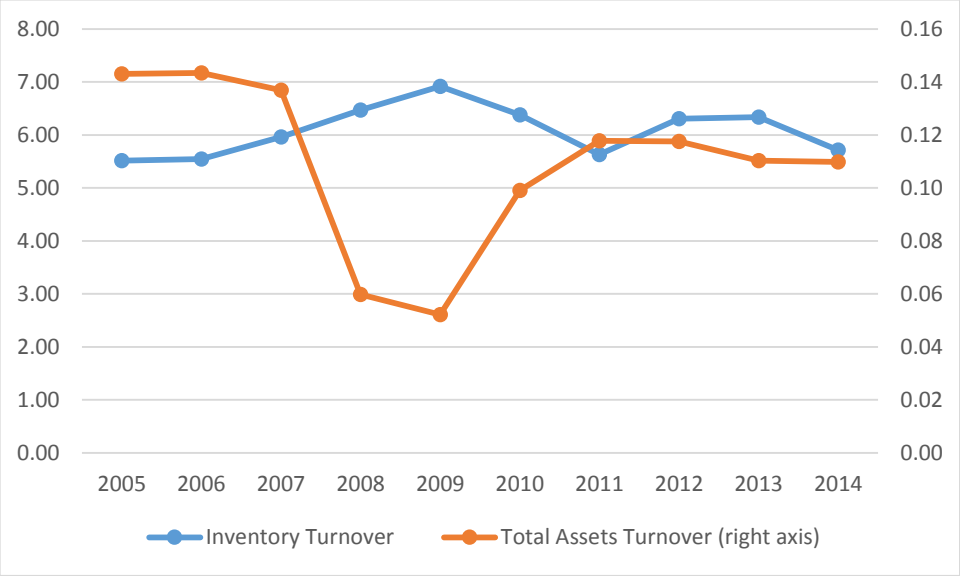
The top poion from 2008 to 2009 was due the debt instrument successfully issued under financial crisis. The golbal market recovery at fist half of 2009, BMW was active on the market as an issuer of bonds, notes in order to refinance its financial service activities[13]. And raising in total more than €5 million on European market, and approximately €760 million in United State, British and Australian.

[12] Financial annual report 2009.
[13] Financial annual report 2009.

Activity Ratio

Through equation (2.8) we can get the result of inventory turnover ratio and through equation (2.9) to calculate total assets turnover ratio. Then we can find out BMW Group's ability of turnover.

Figure 3.9 Inventory turnover



The inventory turnover (Blue curve) kept a stabilized trend from 2005 to 2014 was around 6.08. We can say the efficiency of sales of goods is stable. The total assets turnover was in a bad condition from 2008 to 2009, this is due to the financial crisis 2008 lead to a bad sales volume. In this case the gross profit decreased €6,137 million in 2008[14] compared with previous year.

To sum up, BMW has a healthy financial condition, and with strong ability to operate for a longer period, and the macro-economic index such as GDP, financial crisis has a huge associate with its profits.

The profitability of BMW is always around the level of industry, which indicate the strong position among the automotive industry. And the ability to cover its short-term liability is stable from 2005 to 2014, which indicate the BMW Group has small default risk when deal with its short – term debts. What's more through financial crisis 2008 we can't deny that, BMW Group

[14] Financial annual report 2008.

has an excellent ability of financing in financial market even when the economic around world is not good. So from the results of financial analysis, we can conclude that BMW Group has the potential to expand and with strong ability to operate infinity. In that case, we can continue our evaluation of BMW Group assume it can operate infinity.

4. Estimation of the expected market value of BMW Group

In this part we will apply the methods and models which have been explained in the theoretical part. First of all, we will apply regression analysis to regress out the sales function of BMW Group. And according to the characteristic of automotive industry we can assume some reasonable financial data that may have influence on the sales revenue of cars. Secondly, we will use Monte Carlo simulation to create 10,000 random scenarios in order to estimate the independent variables we use in the revenue function. Then we can calculate sales revenue for predict years from 2015 to 2019. After that, based on the financial plan we can estimate 10,000 scenarios of FCFF, and based on cost of capital and growth rate to calculate the intrinsic value of BMW Group by two-stage DCF method. At last, we use sensitivity analysis to make distribution of the results, and search if the change of growth rate how the expected value would change and make some conclusions with comments.

4.1 Sales Revenue Prediction

To predict the sales revenue, we will use ordinary least square method to regress out the function of sales revenue. Before that, it is necessary to base on the features of automotive industry and BMW Group's own situation to find some items that may have influence on BMW Group's sales revenue. After that we should check the correlations of logarithmic returns between the independent variables. Next step is to use Monte Carlo simulation to simulate 10,000 scenarios random numbers to predict the independent variables in revenue function. At last, the sales revenue prediction will be present at end of this chapter.

4.1.1 Sales Revenue Regression

First of all, it is necessary to collect some independent factors that may have a great relationship to the sales of revenue of BMW Group, and then choice the proper independent portfolio and applied to regression analysis. If the results up to the standard of regression

analysis, we can choice it as revenue function.

Since China, United State and Germany are the most important markets for BMW Group (Figure 3.1), if the economic condition is great in these three country, which will benefit to the final revenues of BMW Group. So consider from macro-economic index, we choice GDP, CPI, disposable personal income per capital, car registration and employed person in these three countries. On the other hand, raw materials such as steel price, oil price will also be taken into consideration.

Annexes 3 includes all independent factors we assume, and pick up from official statistic agent website[15]. And the revenue of BMW Group can pick up from its annual financial report. The detailed interpretation of independent variables are as follows:

GDP[16]: As a mostly used mac-economic index, GDP has great influence to automotive industry. And because the main market for BMW includes China, United Stated and Germany. So, the higher GDP in China, United Stated and Germany lead to a stronger consumption power in these three countries. People in that case are willing to consider buy more luxurious durable goods, which is benefit to increase the revenue of BMW Group.

CPI[17]: The higher CPI in China, United Stated and Germany indicate customer are more willing to spend more money on goods and services. And the higher CPI indicate a better market environment. If the CPI is low, means people don't want to spend added money on goods and services, it would have a bad influence on sales revenue.

Disposable personal income per capital: Disposable personal income is an important indicator to describe the budget for people spending money on durable goods, besides the higher disposable personal income means people have more budget freedom to spend more money on cars.

Steel price: Steel is the vital and necessary raw material for automotive industry, and the price of cost have great influence on the final price. If the steel price is low, which means the less cost for per car, so the final price of a car will be cheaper. But if the price of steel is high, may leads the high price for cars. The price level of cars is also an important factor that influence

[15] http://www.tradingeconomics.com/germany/gdp
[16] Gross Domestic Product
[17] Consumer price index

the consumer's behavior.

Oil price: Oil price is one of the condition that consumers will take into consideration when buying a new car. If the oil price is too high, consumer would like to choice public transport to decrease the trip cost rather than private cars. In this situation, sales of private car will decrease. And the main product for BMW Group is private car, so too high oil price is prejudicial to the sales of BMW Group.

Car registration: The amount of car registrations can directly reflect how many cars sold for one year in each market. The more car registration means the capacity of the market is greater. In that case BMW Group have more chance to sale more cars and the occupied larger market share in these three countries.

Employed person: One of the main income for people is their salaries. So, the more employed person means the more people have surplus and higher budget for purchase a car. On the other hand, more employed person, which indicate more people needs a car to service their business.

Growth rate of GDP in Germany: The growth rate of GDP can stand for the growth speed of economic. Usually the growth rate of GDP has a great associate with imports, exports and consumption power in one country. What's more, the higher growth rate of GDP mean a better economic environment for automotive industry.

After collect these independent data, the next step is use excel regress out the sales function. The steps are: Data→ Data Analysis→ Regression.

In excel we put *Revenue* or $\ln(Revenue)$ into "*Input Y Range*" and then make different portfolio from independent data then put into "*Input X Range*", tick "*Labels*", and select "*output range*" at blank space of excel, and the confidence level is 95%, last press "*OK*". Because we have 18 different independent variables if we choice two different independent variables to create portfolio we can get 153[18] kinds of scenarios, so there exist lots of scenarios. And through p value and R square help to choice the best fit regression function for sales. Because we can't present all scenarios, so we choice three of them show as follow:

[18] We choice 2 different independent variables from 18. So, the equation is: 18*17/2=153.

Table 4.1 Regression Scenario One

Regression Statistics	
Multiple R	0.98745305
R Square	0.975063527
Adjusted R Square	0.96259529
Standard Error	2455.771458
Observations	10

ANOVA

	df	SS	MS	Significant F
Regression	3	1414897641	471632547.1	3.3601E-05
Residual	6	36184880.72	6030813.453	
Total	9	1451082522		

	Coefficients	Standard Error	t Stat	P-value
Intercept	-112528.9672	11937.40688	-9.426583879	8.10266E-05
GDP (Germany）	-9.91089781	3.743359145	-2.647594695	0.03815106
CPI (Germany）	629.0192786	232.9665563	2.700041107	0.03557406
Disposable Personal Income	3.56655225	0.560054901	6.368218974	0.00070408

We use same standards to judge all scenarios we regress out. The p-value of proper sales regression must smaller than 0.05, due to the significant level of 95%. And the coefficient of R square, the greater the better, which means how much our model explains the changes in the dependent variable, by using independent variables.

Where in Table 4.1, the p-value of all the independent variables are smaller than 0.05, and the coefficient of R Square is big enough. But the coefficient of GDP in Germany is negative, which mean the greater GDP in Germany will lead a greater loss of the revenue, this is illogical. So, we cannot use regression scenario one.

Table 4.2 Regression Scenario Two

Regression Statistics	
Multiple R	0.96779
R Square	0.936617
Adjusted R Square	0.918507
Standard Error	3624.803
Observations	10

ANOVA

	df	SS	MS	Significant F
Regression	2	1.36E+09	6.8E+08	6.41E-05
Residual	7	91974385	13139198	
Total	9	1.45E+09		

	Coefficients	Standard Error	t Stat	P-value
Intercept	-1601368	164358.5	-9.74314	2.54E-05
growth rate of GDP (Germany)	68994.26	42424.54	1.626282	0.147916
ln(INC)	156724.5	15492.69	10.11603	1.98E-05

And for regression scenario two, the p-value for growth rate of GDP in Germany is bigger than 0.05, so is also not the proper one.

Table 4.3 Regression Scenario Three

Regression Statistics	
Multiple R	0.980516
R Square	0.961412
Adjusted R Square	0.950387
Standard Error	0.045333
Observations	10

ANOVA

	df	SS	MS	Significant F
Regression	2	0.358416	0.179208	1.13E-05
Residual	7	0.014386	0.002055	
Total	9	0.372802		

	Coefficients	Standard Error	t Stat	P-value
Intercept	-15.9342	2.055517	-7.7519	0.000111
growth rate of GDP (Germany)	1.262501	0.530574	2.379498	0.048918
ln(INC)	2.539111	0.193756	13.10466	3.51E-06

Based on regression scenario two, we try to change the dependent variable "Revenue" to "$\ln(R^{19})$", and the independent variable "personal income in United State" to "$\ln(INC^{20})$", then create regression scenario three. Where in Table 4.3, the p-value for every independent variables is smaller than 0.05, and the R Square is 96%, which means the 96% of the changes in sales revenue explained by our model, So we choice scenario three as the proper one, and express the equation of revenue function according to scenario three.

Table 4.4 Statistic data for regression model

Year	ΔGDP(Germany)	$\ln(INC)$	$\ln(R)$
2005	0.007	10.48816	10.75056
2006	0.037	10.4948	10.79956
2007	0.033	10.59172	10.93343
2008	0.011	10.56806	10.88176
2009	-0.056	10.58099	10.83331
2010	0.041	10.60023	11.01002
2011	0.036	10.6533	11.13926
2012	0.004	10.69648	11.24958
2013	0.001	10.69569	11.23926
2014	0.016	10.69487	11.29478

Table 4.4 is the statistic data used for scenario three. The $\ln(R)$ is dependent variable, the ΔGDP and $\ln(INC)$ is independent variables. According to scenario three, the equation can be described as:

$$ln(R) = -15.94 + 1.26 \cdot \Delta gdp + 2.54\, ln(inc). \quad (4.1)$$

Formula (4.1) is the regression function for BMW Group's $ln(R)$, and to calculate "Revenue" we should use excel to "Exp" the final answer. The "Δgdp" is the growth rate of GDP in Germany, and abbreviation "inc" is the disposable personal income per capital in USA (Unit: Million euro). Where in equation (4.1), both growth rate of GDP in Germany and disposable personal income per capital in USA have positive relationship to the revenue of

[19] Revenue
[20] Income

BMW Group, which means the growth of Δgdp and personal income in USA the more revenue the BMW Group will obtain, and is also conform to the actual situation.

4.1.2 Monte Carlo Simulation

In this part we will use excel to apply Monte Carlo Simulation. First of all we should create 5 years random numbers for each independent variables, in order to simulate sales revenue in future 5 years. The steps to create random numbers are: Data→ Data Analysis→ Random Number Generation.

The reason to create 10,000 random numbers is to make the final results more accurate. Because the more random numbers we create means the higher possibility to get the accurate result. And because we have two different independent variables, for each independent variable we should create 5 years random numbers to support revenue calculation, so the "number of variables" is 10. Furthermore, select random numbers distributed normally. Finally choice the output range at blank space in excel and press "OK", then we can get random numbers.

The next step is to check whether we need to fix the correlation of independent variables to respect the random data. If the correlation between the logarithmic return is too high, we need to adjust the normal distributed random number to proper correlation by using Cholesky decomposition. And if the correlation is low, so it is not necessary to use Cholesky decomposition.

Because in our thesis, the input data "△GDP" is negative from 2008 to 2009, so we use the relative changes instead of the logarithmic returns.

Table 4.5 Relative changes

Log R(Inc)	Log R(Δgdp)
4.285714	0.00666
-0.10811	0.10178
-0.66667	-0.02339
-6.09091	0.013017
-1.73214	0.019427
-0.12195	0.054504
-0.88889	0.044127
-0.75	-0.00079
15	-0.00082

After getting the result of logarithmic return, we can use excel to calculate the correlation between these two independent variables. The steps are: Data→ Data Analysis→ Correlation. The result of correlation as follow:

Table 4.6 Correlation between logarithmic return

	Log R(INC）	Log R(∆GDP)
Log R(INC）	1	
Log R(∆GDP)	-0.19805	1

From table 4.6 it is clear to state that the correlation between logarithmic return is small, so we don't need to adjust the normal distributed random number to proper correlation by using Cholesky decomposition. So the next step is to check the correlation between random numbers we created.

Table 4.7 Correlation for random variables from 2015 to 2019

2015	INC (USA)	△GDP
INC (USA)	1	
△GDP	-0.001655	1

2016	INC (USA)	△GDP
INC (USA)	1	
△GDP	0.0250208	1

2017	INC (USA)	△GDP
INC (USA)	1	
△GDP	0.0042113	1

2018	INC (USA)	△GDP
INC (USA)	1	
△GDP	0.012297	1

2019	INC (USA)	△GDP
INC (USA)	1	
△GDP	0.0169272	1

From table 4.7 we can state that, the correlation of random value from 2015 to 2019 is very small, and different for each year. In this condition we can accept the random number created by excel.

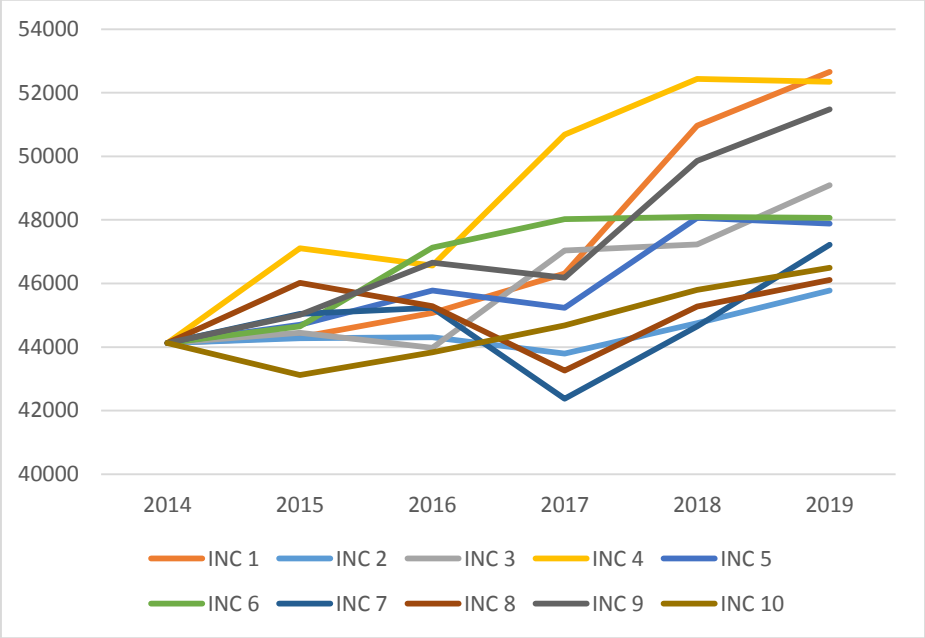
And then we can continue to predict the independent variables. And we use Geometric Brownian Motion to predict the disposable personal income per capital in USA. According to formula (2.19), first of all we can calculate "μ", and based on formula (2.20) to calculate"∂", and σ is the standard deviation， so we can use excel “STDEV.P” to get the result.

Table 4.8 Mean and Standard Deviation

μ	0.0230
σ	0.0341
α	0.0224

Where in table 4.8 we present all the factors we need to apply Geometric Brownian Motion. Then back to the 10,000 scenarios random data we created before, to predict disposable personal income per capital in USA and applied to formula (2.21)，then we can estimate the result of USA personal income in future five years. Figure 4.1 present 10 of predicted INC randomly pick up from 10,000 scenarios.

Figure 4.1 Estimated INC (Unit: Million Euro)



From Figure 4.1 we can see that the estimated INC change randomly, and with the trend of increase.

As for predict the growth rate of GDP in Germany, we use Vasicek Model. This is because Vasicek Model is about long equilibrium and growth rate can be negative or positive. And according to the formula (2.23) first of all we should calculate long-run mean "*b*" and velocity "*a*" and in order to calculate factor "*b*" and "*a*" we should use regression analysis to identify the "α" and "β".

Table 4.9 Input data for regression analysis

Year	Growth rate of GDP	∆Growth rate of GDP
1996	0.008	
1997	0.018	0.01
1998	0.02	0.002
1999	0.02	0
2000	0.03	0.01
2001	0.02	-0.01
2002	0.001	-0.019
2003	-0.01	-0.011
2004	0.013	0.023
2005	0.007	-0.006
2006	0.037	0.03
2007	0.033	-0.004
2008	0.011	-0.022
2009	-0.056	-0.067
2010	0.041	0.097
2011	0.036	-0.005
2012	0.004	-0.032
2013	0.001	-0.003
2014	0.016	0.015

Table 4.5 is the input data for regression analysis, and “Growth rate of GDP” (Germany) is independent variable and “∆Growth rate of GDP” is the dependent variables. Because Vasicek Model is about is about long equilibrium, so we select growth rate of GDP in Germany from 1996 to 2014, in order to estimate growth rate of GDP more accurate. And through regression process in excel, we can get the result below:

Figure 4.9 Regression Output

Regression Statistics	
Multiple R	0.728066
R Square	0.53008
Adjusted R Square	0.50071
Standard Error	0.022947
Observations	18

ANOVA

	df	SS	MS	Significant F
Regression	1	0.009504	0.009504	0.000613325
Residual	16	0.008425	0.000527	
Total	17	0.017928		

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.014211	0.006305	2.253959	0.038574
△growth rate of GDP	-1.059	0.249275	-4.24833	0.000613

From Figure 4.9 we can state that the p-value is smaller than 0.05, so the result is significant. So we can get "α" equals to 0.0142, "β" equals to -1.059. And then we can calculate factor “a”, “b” and other factors.

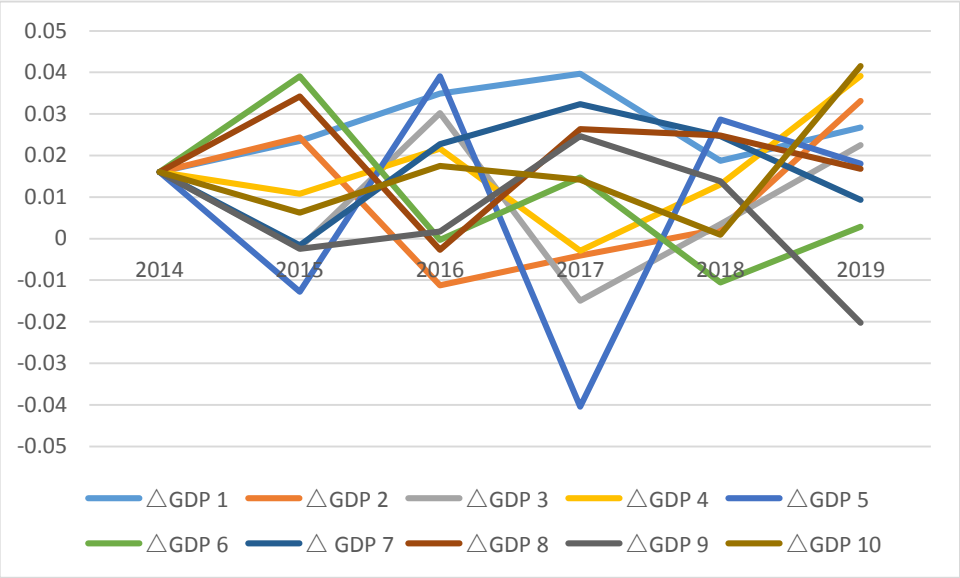
Table 4.10 Factors for Vasicek Model

α	0.0142
β	-1.059
t	1
a	1.0590
b	1.342%
Std	2.113%

Table 4.10 is the result of factors needed to apply for Vasicek Model. The last step is back to random data we created and apply these factors to the equation (2.23). In that case we can get 10,000 scenarios of results for growth rate of GDP in Germany. Figure 4.2 present 10 of scenarios of ΔGDP randomly pick up from 10,000 scenarios. And it is clearly

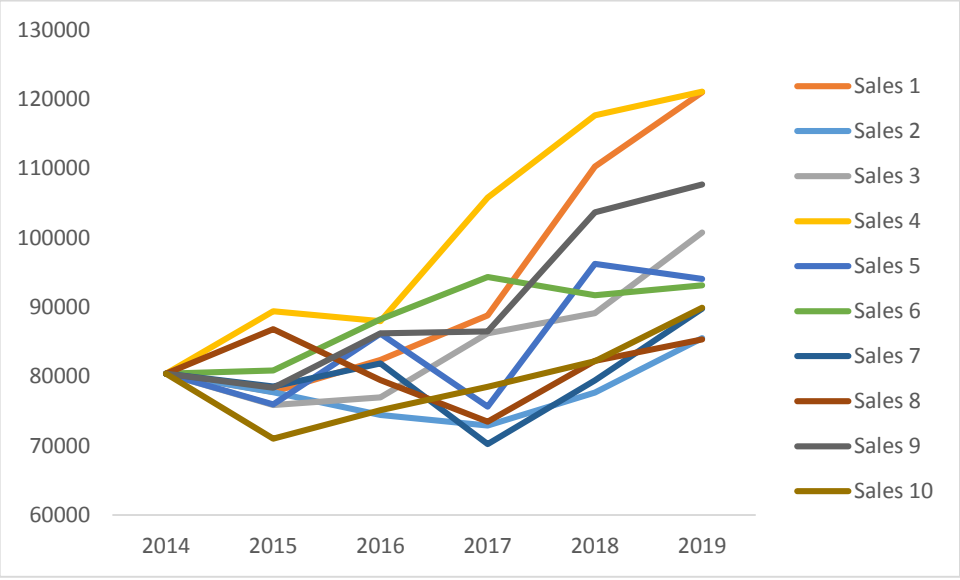
to see the ΔGDP changed randomly under different risks.

Figure 4.2 Estimated ΔGDP



After finished predict disposable personal income per capital in USA and growth rate of GDP in Germany, according to formula (4.1) we can get "$\ln(R)$", and then use excel "Exp" the result, financially we can get 10000 scenarios revenue from 2015 to 2019. And we choice 10 scenarios of sales revenue randomly to present the trend of revenue prediction.

Figure 4.3 10 samples of sales revenue prediction (Unit: Million euro)



In Figure 4.3, there is only 10 sales revenue prediction pick up from 10,000 scenarios results randomly. And these 10 sales revenue with the trend of increase as a whole and changes independently under different kinds of risks.

4.2 Financial Plan

Financial plan is the preparatory work for two – stage *DCF* method. And this part includes plan of *EBIT*[21], plan of *NWC*[22], plan of investment, plan of deprecation and plan of tax rate. And we will start with plan of *EBIT*.

Plan of EBIT

We can use operating margin to predict the earnings before interest and tax. Specifically, we can find the relationship between *EBIT* and total revenue according to the historical data from 2005 to 2014, then quantify the operating margin, in order to predict the future *EBIT*.

Table 4.11 Operating Margin of BMW Group from 2005 to 2014 (Unit: Million euro)

Year	EBIT	Revenue	Operating Margin
2005	3793	46656	8.130%
2006	4050	48999	8.265%
2007	4212	56018	7.519%
2008	921	53197	1.731%
2009	289	50681	0.570%
2010	5094	60477	8.423%
2011	8018	68821	11.651%
2012	8300	76848	10.801%
2013	7978	76059	10.489%
2014	9118	80401	11.341%

[21] Earnings before interest and tax
[22] Net working capital

Where in table 4.11 according to the input data EBIT and revenues, we can calculate the operating margin from 2005 to 2014. In general, the operating margin is not very stable, but except the influence of financial crisis in 2008 and 2009, the operating margin in other years are around 10%. And then we give different weight to operating margin with different years. Because years from 2005 to 2009 are far away from now, so the weight we assume is relatively lower than recent years. To the contrary, give relatively higher weight to recent years. And the sum of weight for 10 years should equal to 100%.

Table 4.12 Operating Margin with weight

Year	Operating Margin	Weight
2005	8.130%	1%
2006	8.265%	2%
2007	7.519%	2%
2008	1.731%	3%
2009	0.570%	5%
2010	8.423%	7%
2011	11.651%	9%
2012	10.801%	11%
2013	10.489%	20%
2014	11.341%	40%
SUM		100%

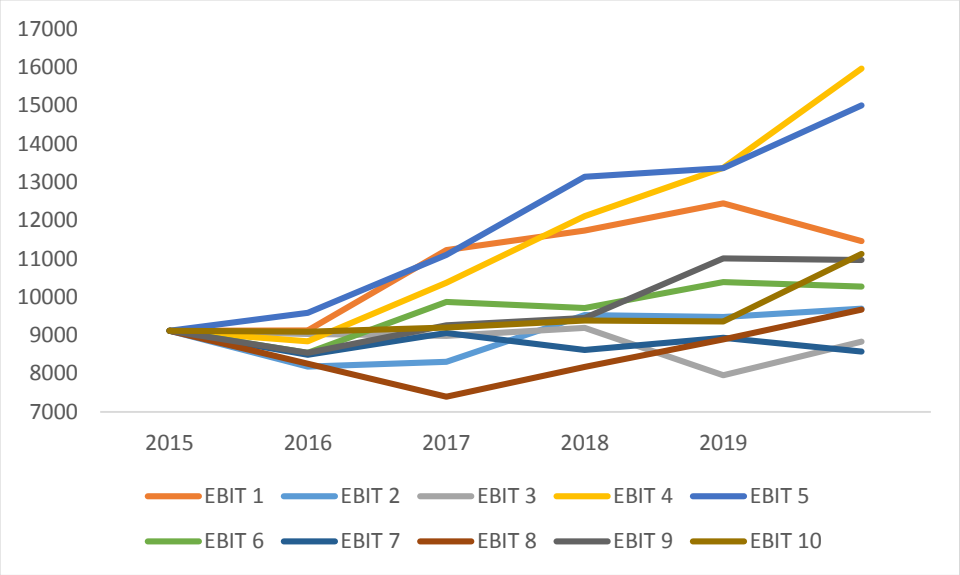
From table 4.12 the operating margin from 2005 to 2014 with different weight, and according to formula (2.26) and (2.27) we can calculate the weighted average operating margin equal to 0.094.

$$\sum_{i=1}^{t} k_i \cdot w_i = 0.094,$$

And because we have already predicted the 10,000 scenarios revenue in future 5 years, so we can continue utilize operating margin to calculate 10,000 scenarios EBIT in 5 years.

Specifically we can use revenues predicted before times the fixed operating margin 0.094, and then we can get 10,000 scenarios of EBIT from 2015 to 2019. While we can't present all scenarios of EBIT on thesis, so we pick 10 of them graphed below.

Figure 4.4 10 Sample Scenarios of EBIT Prediction (Unit: Million €)



From figure 4.4 we can clearly see the trend of 10 examples of predicted EBIT fluctuated randomly. In generally most of EBIT in the predict year stay the trend of increase, which means the earnings of BMW Group have great chance to increase in the future according to our estimated.

Plan of Net Working Capital

Net working capital always associate with current assets and current liabilities, and the differences between current assets and current liabilities is net working capital. So, first of all we can find the ratio of current assets divided revenues and current liabilities divided revenues. And according to the historical data of revenues, current assets and current liabilities from 2005 to 2014 we can calculate the result of the ratio as follows:

Table 4.13 Result of CA/Revenue and CL/Revenue (Unit: Million euro)

Year	CA[23]	CL[24]	Revenues	CA/Revenue	CL/Revenue
2005	27010	28084	46656	58%	60%
2006	28543	28555	48999	58%	58%
2007	32378	33784	56018	58%	60%
2008	38670	39287	53197	73%	74%
2009	39944	36919	50681	79%	73%
2010	43151	40134	60477	71%	66%
2011	49004	47213	68821	71%	69%
2012	50514	48431	76848	66%	63%
2013	52184	51134	76059	69%	67%
2014	56844	59078	80401	71%	73%

From table 4.13 we can see the input data and final results of CA/Revenue and CL/Revenues. And in the last five years, the ratio of CA/Revenues is relatively stable, averaged 70%, so we use 70% to predict the current assets in future five years. On the other hand, years from 2005 to 2009 are far away from now, so we also use the average ratio of latest five years to predict current liabilities. And the ratio to predict current liabilities is around 68%.

CA/Revenue=70% CL/Revenue=68%

Since, we already predicted 10,000 scenarios of revenues before, so according to the ratio we calculated above, it is easier to get 10,000 scenarios of current assets and current liabilities for predict years. The figure below are the examples of current assets and current liabilities we estimate.

[23] Current Assets
[24] Current Liabilities

Figure 4.5 Prediction of Current Assets (Unit: Million euro)

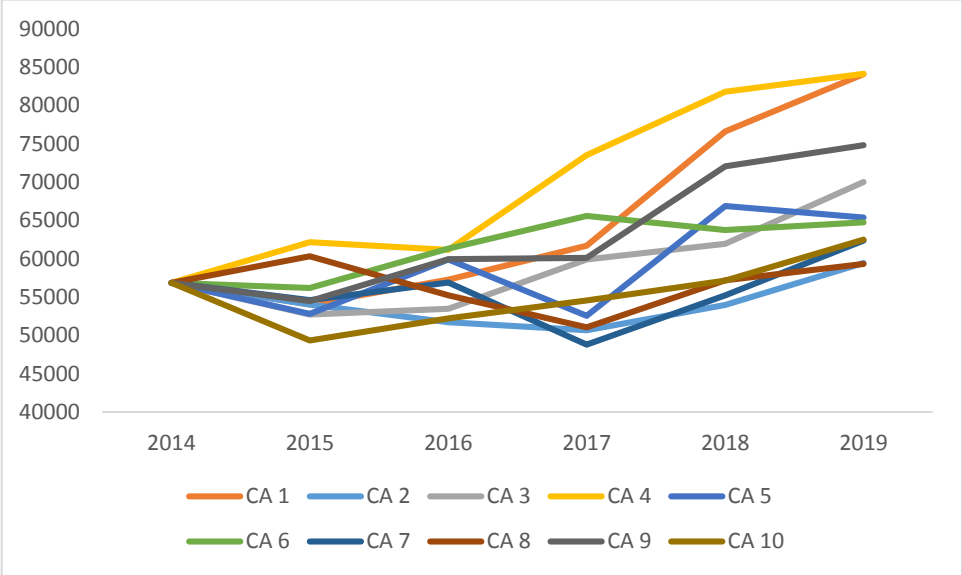
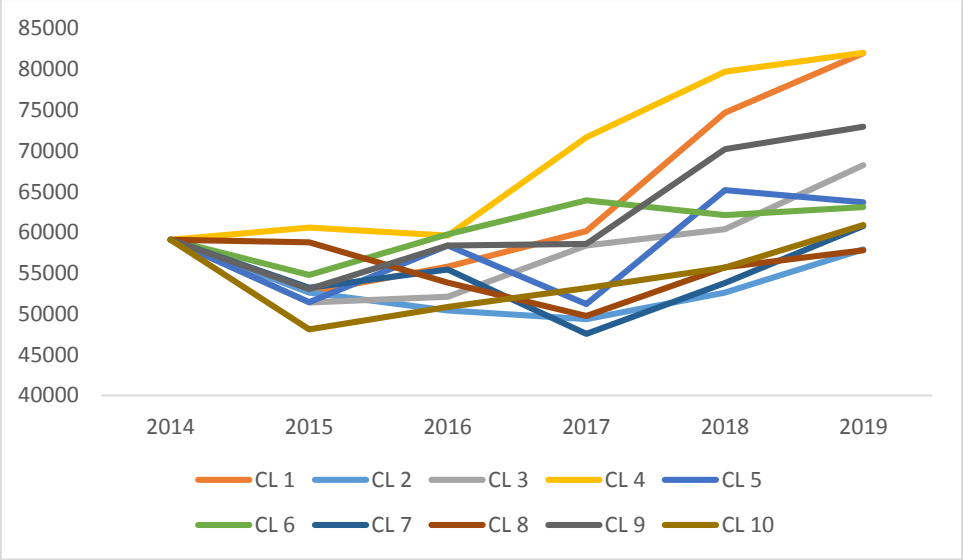


Figure 4.6 Prediction of current liabilities (Unit: Million euro)



Where figure 4.5 is the prediction of current assets and figure 4.6 shows the prediction of current liabilities. Because we can't present 10,000 scenarios of current assets and current liabilities, so we randomly pick up 10 examples. And both current assets and current liabilities has a trend of increase in the future.

After getting the result of current assets and current liabilities for predict years. The differences between current assets and current liabilities are the net working capital. And then use the base year minus previous year is the change of net working capital (ΔNWC). The

average value of ΔNWC is the final result we compute and use in predict the FCFF. The result of average value of ΔNWC from 2015 to 2019 present below.

Table 4.14 Prediction of ΔNWC (Unit：Million euro)

Year	2015	2016	2017	2018	2019
ΔNWC	3674.43	92.34	95.24	100.17	111.37

Plan of Investment

To predict the investment in the future, we need to consider BMW's historical investment condition, at same time combine its new investment plan, and only in this way we can predict BMW Group's future investment more accurate.

Table 4.15 Investment from 2005 to 2014 (Unit: Million euro)

Year	Investment	Growth rate of Investment	Weighted
2005	2098		
2006	2166	3.2%	2.5%
2007	2200	1.6%	2.5%
2008	2178	-1.0%	2.5%
2009	2190	0.6%	2.5%
2010	2589	18.2%	2.5%
2011	2565	-0.9%	7.5%
2012	3210	25.1%	10.0%
2013	3784	17.9%	35.0%
2014	3520	-7.0%	35.0%
SUM			100%

Where in table 4.15 we present the historical data of investment from 2005 to 2014. And from historical data of investment we can see the value of investment was not very stable, this is because for every year BMW has new plan to promote develop. We can through the growth

rate of investment to predict the investment in future 5 years. From table 4.15 we can state that although the growth rate of investment fluctuate largely, but most of years with the trend of increase. And we give the different weight to different years, the sum of weight should equals to 100%. Last we use weighted average method to calculate the growth rate of investment is 6.8%. So, we can get the result of predicted investment below:

Table 4.16 Prediction of Investment (Unit: Million euro)

Year	2015	2016	2017	2018	2019
Investment	3760.29	4016.98	4291.19	4584.12	4897.05

Plan of Depreciation

As we all know fixed assets always accompanied with depreciation, so in order to predict the depreciation we should predict fixed assets first. As we already predicted investment from 2015 to 2019, so the fixed assets for predict year is to use the fixed assets in previous year plus new investment.

Table 4.17 Fixed assets prediction form 2015 to 2019 (Unit: Million euro)

Year	Investment	Fixed assets
2015	3760.29	101719.29
2016	4016.98	105736.27
2017	4291.19	110027.46
2018	4584.12	114611.58
2019	4897.05	119508.63

Table 4.17 present the fixed assets we estimated for predict year, because of the increase trend of investment, so the fixed assets is also with the trend of increase. So the next step is to calculate the deprecation rate according to the historical data of fixed assets and deprecation from 2005 to 2014.

Table 4.18 Deprecation rate from 2005 to 2014

Year	Fixed Assets	Deprecation	r(Dep[25])
2005	47556	1989	4.18%
2006	50514	2083	4.12%
2007	56619	2123	3.75%
2008	62416	2112	3.38%
2009	62009	2088	3.37%
2010	67013	2219	3.31%
2011	74425	2437	3.27%
2012	81336	2411	2.96%
2013	86193	2672	3.10%
2014	97959	3102	3.17%
Average dep. rat			3.16%

Where in table 4.18 we get the deprecation rate for each year. And it is clear to see that for recent years the depreciation rate is very stable and averaged 3.16%. So, the average of deprecation rate from 2010 to 2014 can as the deprecation rate which we will use in next step.

The next step is to use the fixed assets we predict times the averaged deprecation rate from 2010 to 2015. So we can get the depreciation for predict years.

Table 4.19 Deprecation Prediction from 2015 to 2019 (Unit: Million euro)

Year	Fixed Assets	Depreciation
2015	101719.29	3217.71
2016	105736.27	3344.78
2017	110027.46	3480.53
2018	114611.58	3625.54
2019	119508.63	3780.45

Where table 4.19 present the predicted value of depreciation form 2015 to 2019, and we can see that the amount value of depreciation we predicted is smaller than the investment we predicted.

[25] Depreciation

Estimated of tax rate

Tax rate is a necessary factor that should take into consideration when we come put EAT. The tax policy in Germany is relatively stable, so we use the average tax rate from 2010 to 2014.

Table 4.19 Tax rate prediction (Unit: Million €)

Year	Income tax expense	EBIT	Tax rate
2010	-1602	5094	31%
2011	-2476	8018	31%
2012	-2697	8300	32%
2013	-2564	7978	32%
2014	-2890	9118	32%
Average tax rate			31.7%

From table 4.19, we can see the historical data of income tax expense and EBIT from 2010 to 2014, so we can calculate historical tax rate through income tax expense divided EBIT. And the tax rate from 2010 to 2014 is very stable. Finally we can use the average tax rate 31.7% as estimated tax rate in future 5 years.

Expected Random FCFF Evaluation

We can calculate FCFF according to the equation（2.24）. Since we have been already predicted EBIT, change of net working capital (∆NWC), investment (INV), depreciation and tax rate above, so the summary results of items for financial plan are as follow:

Table 4.20 Data for estimation of FCFF (Unit: Million €)

	2015	2016	2017	2018	2019
EBIT	8038.735	8554.037	9085.572	9644.625	10266.13
DEP	3217.713	3344.784	3480.528	3625.539	3780.448
∆NWC	3674.43	92.34	95.24	100.17	111.37
INV	3760.29	4016.98	4291.19	4584.12	4897.05
Tax rate	31.7%				

Where in table 4.20 we present all estimate items for calculate FCFF. We estimated 10,000 scenarios of EBIT, and ΔNWC, but in Table 4.20 is the average value of 10,000 scenarios of EBIT and ΔNWC. So we can get 10,000 scenarios of FCFF. Since we can't present all scenarios of FCFF, so we pick up 10 of them randomly.

Figure 4.8 10 Sample Scenarios of FCFF Prediction

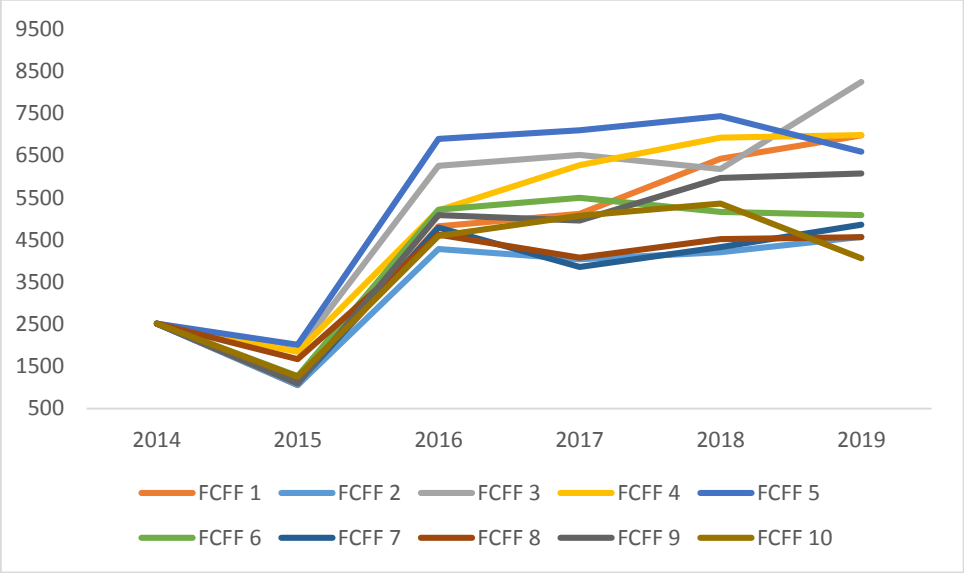


Figure 4.8 shows the 10 examples of FCFF for predicted years. And most of examples have the trend of increase. The decrease trend of FCFF in 2015 is due to the ratio of current liabilities divided by revenues in 2014 is 5% higher than the ratio we use to estimate, so the consequence is although the revenues we estimate will increase in 2015， but the estimated current liabilities and current assets in 2015 is smaller than 2014. So in 2015 the estimated current assets is bigger than estimated current liabilities. That cause the decrease FCFF in 2015. After 2015, the FCFF we predicted with the trend of increase and change randomly.

4.3 Cost of Capital Calculation

In this part we will calculate weighted average cost of capital according to formula (2.29). So, first of all we should calculate the cost of equity and cost of debt.

4.3.1 Cost of Equity

CAPM model will be applied to calculate cost of equity, so first of all we need identity risk free rate, risk premium and β coefficient.

For risk free rate, we will use the return of long-term Germany government bonds as risk free rate. And for the first phase we use the return of 5 years Germany government bonds, and second phase we use the return of 30 years Germany government bonds. We can find the information on Bloomberg Business[26].

$$R_f(10) = 0.23\% \qquad R_f(30) = 1.4\%$$

For the risk premium, we can found the risk premium on website Damodaran. And the value of Germany is 6%[27].

For β coefficient, we found unleveraged β for automotive industry in Euro zone at website Damodaran[28] is 0.82, so we should use equation (2.32) to calculate leveraged β for automotive industry in European market.

$$\beta^l = 2.57$$

As we already known all the input data to calculate cost of equity, so according to equation （2.30）the result of cost of equity for two stage are:

$$\mathrm{E}(R_e) = 15{,}68\% \qquad E(R_e)=16.85\%.$$

4.3.2 Cost of Debt

To estimate cost of debt we can use the interest expense divided by the latest two years average debt. And from annual financial report the interest expense in 2014 is €1266 million，the average financial debt for 2013 and 2014 are €33482 million. So, we can calculate the cost of debt is:

$$1266 / 33482 = 3.78\%.$$

After getting cost of equity and cost of debt, we can calculate weighted average cost of

[26] http://www.bloomberg.com/markets/rates-bonds/government-bonds/germany
[27] http://pages.stern.nyu.edu/~adamodar/
[28] http://pages.stern.nyu.edu/~adamodar/

capital according to formula (2.29). And the results are:

$WACC_1 = 5.75\%$ $WACC_2 = 6.03\%$

4.4 Estimate Value of BMW Group

In this part we will compute the valuation of BMW Group. First of all we should identify the gross rate of BMW Group, since we already predict 10,000 scenarios of FCFF in future 5 years, so can use the average increase rate of last two years FCFF, which equals to 4.66% as gross rate. From now on we have already come put all factors needed for two – stage DCF method.

The first phase is from business 2015 to 2018. And according to two stage DCF method, first of all we can calculate the valuation for the first phase. By applying FCFF from 2015 to 2018 and $WACC_1$ we can get 10,000 scenarios of valuation for the first phase.

The second phase is from business year 2019 to infinities. For the second phase we will use the growth rate with 4.66%, $WACC_2$ and by applying FCFF 2019, we can get 10,000 scenarios of valuation for the second phase.

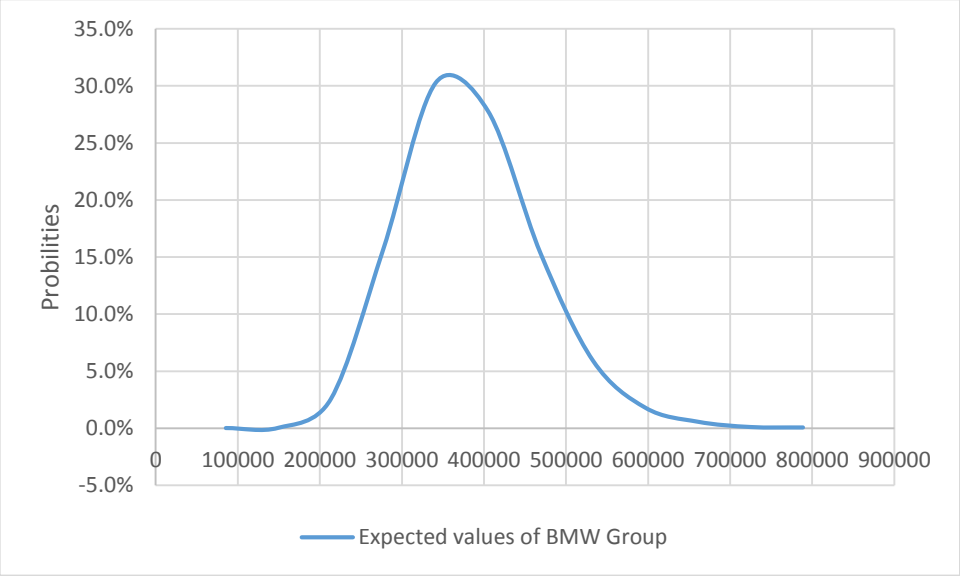
Finally sum the valuation of first phase and second phase, then we can get the 10,000 scenarios of valuation for BMW Group.

In order to have a better analysis of 10,000 scenarios of valuation for BMW Group, we can make a probability distribution of these valuation and shows in graph. So, the first step is to calculate the average of company's valuation and find the minimal and maximum valuation. Then we can give 12 intervals, and use excel to compute the frequencies of these predicted valuation. Last, we can do probability distribution for 10,000 scenarios of valuation for BMW Group.

Table 4.22 Valuation frequency (Unit: Million €)

Valuation interval	Frequency	Probability
85374.8	1	0.0%
149305.5	3	0.0%
213236.2	254	2.5%
277166.9	1567	15.7%
341097.6	3027	30.3%
405028.3	2777	27.8%
468959	1531	15.3%
532889.7	590	5.9%
596820.5	178	1.8%
660751.2	56	0.6%
724681.9	10	0.1%
788612.6	6	0.1%
Total	10000	100%

Figure 4.9 Probability distribution of values



From figure 4.9, we can see the probability distribution of BMW Group's valuation. And the distribution is close to normal distribution. What's more， from table 4.22 we can see

that the most frequency interval is between €341097.6 million and €405028.3 million. So we can say the market value of BMW Group we estimated is the mean of €341097.6 million and €405028.3 million, and the result is €373062 million. And the probability distribution values of BMW Group range from €85374.8 million to €788612.6 million. In addition, from the balance sheet 2014 found the book value of BMW Group is €154803million， and compared with the expected value we estimated the book value is much lower than we expected. To sum up, BMW Group is undervalued, so it has much space to develop.

Table 4.23 Estimated characteristics of the value distribution of BMW Group
(Unit: Million euro)

E(V)	373062
Std.(V)	82320
Max(V)	788613
Min(V)	85375
Percentile (10%)	253419
Percentile (5%)	231294
Percentile (1%)	193494
Percentile (0.01%)	110728

From table 4.23 we can see that, the valuation of BMW Group we estimated is around €373062 million, and the standard deviation is €82320 million，and the maximum and minimum probability distribution of BMW Group‘s valuation respectively are €788613 million and €85375 million. And the percentile with 10% means there exist 90% of chance that the valuation of BMW Group is greater than €253419million. We can explain percentile with level at 5%, 1% and 0.01% with same way. So, we can state that close to 100% the valuation of BMW Group will greater than €110728 million. In summary, BMW Group is a promising company with a bright future, and have huge space to develop.

4.5 Sensitivity Analysis

Sensitivity analysis is a necessary process of valuation. And through sensitivity analysis we can test how the valuation of BMW Group changes with the change of factors we valued. So in this part, we will have a sensitivity analysis on growth rate.

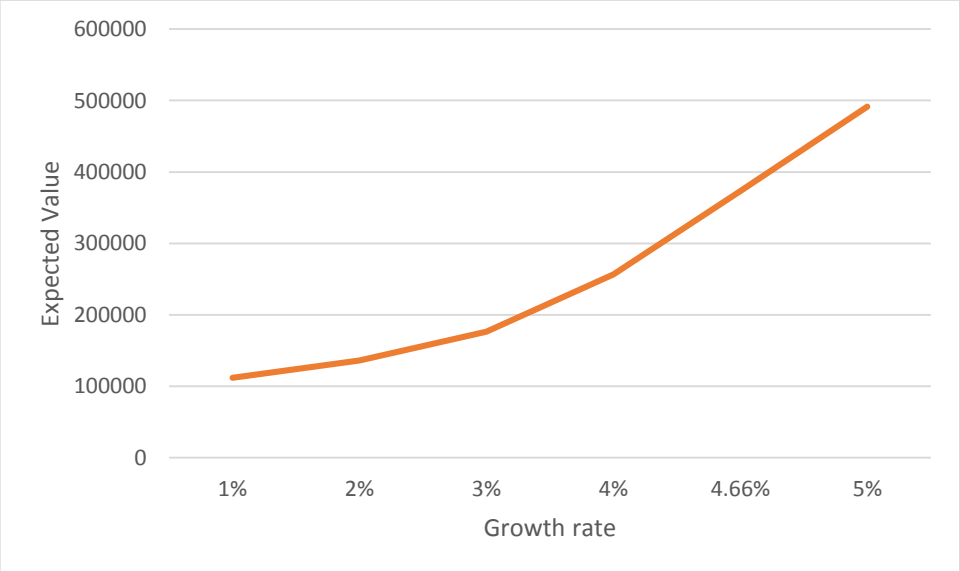
As we calculated before, the growth rate of BMW Group is 4.66%, and we also estimated 10,000 scenarios of valuation of BMW Group. Hence, according to two – stage DCF method, if we change the number of growth rate the final result will change responsibly.

Table 4.24 Valuation with change of growth rate (Unit: Million euro)

Growth rate	1%	2%	3%	4%	4.92%	5%
Expected Value	111858	136157	176484	256503	373062	491597

From table 4.24 we can state that, with the change of growth rate, the valuation of BMW Group also changed responsibly. The original growth rate for BMW Group is 4.92% with the valuation is €426166.3 million. But with the increase of growth rate, the intrinsic value we expected also increased. Logically, the faster a company developed, and the greater expected value will estimated. From the figure below, we can see the relationship between growth rate and intrinsic value more clearly.

Figure 4.10 Expected value with change of growth rate (Unit: Million euro)



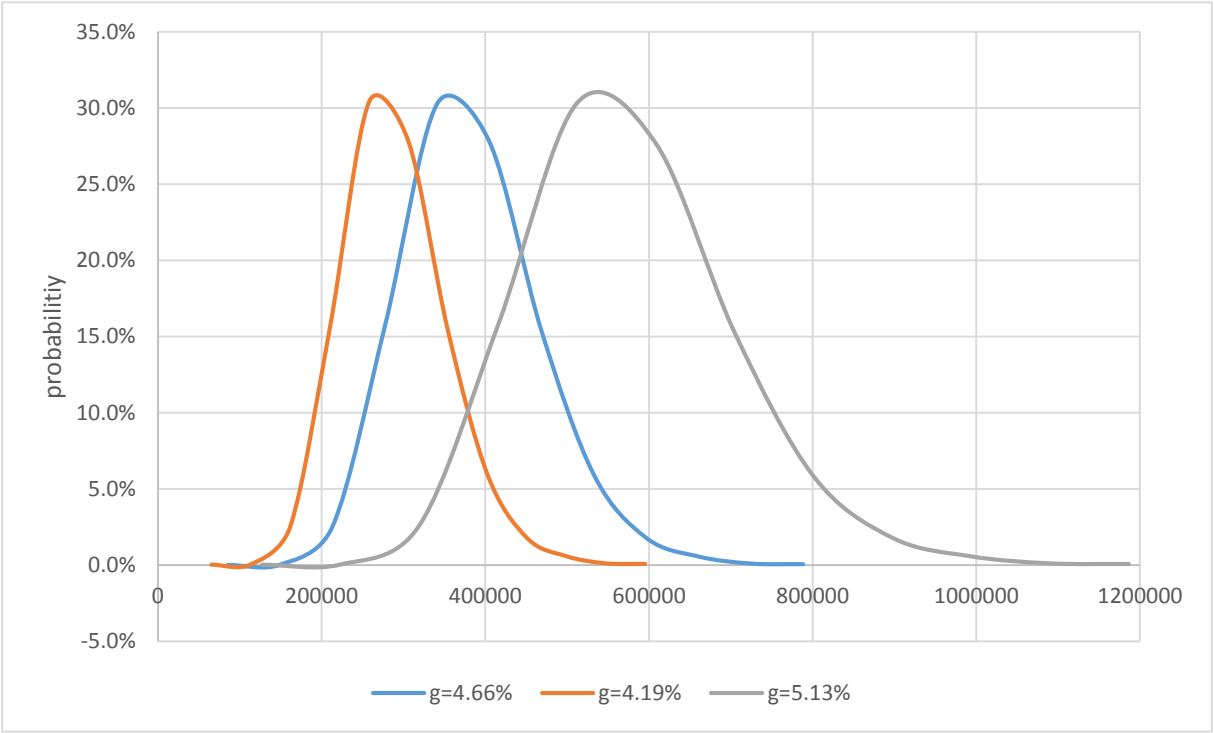
From figure 4.10 it is clear to see the positive relationship between growth rate and the expected value of BMW Group. And with the increase of growth rate the increase speed of expected value is also increase respond. So, the next step we will compare the probability distribution of the intrinsic value with the change of growth rate.

Table 4.25 Change of the growth rate

Growth Rate	
5.13%	10%
4.66%	0
4.19%	-10%

From table 4.25 we can state that the original growth rate we estimated is 4.66%, if the growth rate increase 10%, the result is 5.13%, and if the growth rate decrease 10%, the result is 4.19%. The decrease or increase of the growth rate indicate the company will expand faster or slower.

Figure 4.11 Probability distributions with different growth rates



From figure 4.11 we can see the probability distributions of the market value with 3 different growth rates. If we draw a horizontal lines at probability 31%, we can see that the intrinsic value of orange curve with 4.19% growth rate has 31% possibility to get the €257927 million; the blue curve with 4.66% growth rate has 31% possibility to get €34109716 million； the gray curve with 5.13% growth rate has 31% possibility to get €512307 million. So, we can conclude that with the same probabilities level, higher growth rate will achieve higher expected value.

And from figure 4.11, the higher growth rate with longer distributions, so the standard deviation is bigger, which indicate the faster growth rate will exist more possible to achieve higher market value, but at same time the possibility of stable development will decrease. In other words, high growth rate followed with higher risk.

5. Conclusion

BMW Group is one of the world's most respected car manufacturer and also provide premium financial and mobility service. Products for BMW Group are famous for its high performance and luxury. And seeing form the whole industry, the automotive industry around the world has been experiencing a strong profitability and growth rate.

Firstly, from financial analysis we can concluded that BMW Group has ability to operate longer, at the same time the macro-economic element such as global financial crisis, has a huge attack with its gross profit. Specifically, the profitability of BMW is around the industry level, and the ability to cover its short-term liabilities is stable. What's more through financial crisis 2008 we can state that, BMW Group has an excellent ability of financing in financial market, investors are willing to invest on it and with great investment confidence. So from the financial analysis we can concluded that BMW Group has the potential to expand and operate for a longer period.

Then to sum up the estimation of the valuation of BMW Group, the average of 10,000 scenarios of valuation is €351402 million，and we can see that the most frequency interval is between €341097 million and €405028 million. so we can state that the expected value of BMW Group we estimated is the average of €341097 million and €405028 million, equals to €373062 million，and compared with the book value €154803 million，BMW Group is undervalued. So we infer the company have huge development space, and operating well. And from explanation of percentile, we can state that close to 100% the valuation of BMW Group will greater than €132797 million. In summary, BMW Group is a promising company with a great development space.

Finally, from the sensitivity analysis we can state that, the growth rate of BMW Group is a vital items for its valuation. And the relationship between growth rate and expected value is positive, and with the same probabilities, higher growth rate will achieve higher expected value. What's more, although the greater growth rate will exist more possible to achieve higher expected value, but at same time the possibility of develop stable will decrease. In other words, high growth rate followed higher risk.

Broadly speaking, BMW Group has a healthy financial condition with strong ability to operate longer period, and the expect value is greater than the book value. So, we can conclude that BMW Group is a promising company with huge expand space.

Bibliography

a) Professional books

[1] Monahan, J.F. *Numerical methods of statistics*: Cambridge University Press, 2001. ISBN 978-0521139519

[2] HITCHNER, R. James. *Financial Valuation, Applications and Models.* New Jersey: John Wiley & Sons, 2011.ISBN 978-0470506875

[3] KOLLER, T., M. GOEDHART and D. WESSELS. *Valuation: Measuring and Managing the Value of Companies*. New York: McKinsey & Company Inc., 2010. ISBN 978-0470424650.

[4] SALTELLI, A et al. *Global Sensitivity Analysis.* New Jersey: John Wiley & Sons, 2008. ISBN 978-0-470-05997-5

[5] SIMON, Benninga. *Financial Modeling*. 4th ed. New York: The MIT Press, 2014. ISBN: 978-0262027281.

[6] ZMESKAL, Zdenek et al. *Financial Models*. Ostrava: VSB-Technical University of Ostrava, 2004. ISBN 80-248-0754-8.

b) Electronic documents and others

[6] Damodaran Online, Financial indicators for automotive industry. [Online]. [20.2.2016]. Available on: http://pages.stern.nyu.edu/~adamodar/

[7] Government Bond Yields for periods. [Online]. [20.2.2016]. Available on: http://www.bloomberg.com/markets/rates-bonds/government-bonds/germany

[8] Book value for BMW Group. [Online]. [22.2.2016]. Available on: Data form: https://finance.yahoo.com/q?s=BMW.DE

[9] Independent variables for regression analysis. [Online]. [19.1.2016]. Available on: http://www.tradingeconomics.com/germany/gdp

[10] Financial Annual Report from 2005 to 2014. [Online]. [4.1.2016]. Available on: https://www.bmwgroup.com/en.html

[11] Most valuable brands within the automotive sector worldwide as of May 2015, by brand value. [Online]. [3.8.2016]. Available on:http://www.statista.com/statistics/267830/brand-values-of-the-top-10-most-valuable-car-brands/

List of Abbreviations

DCF	Discounted cash flow
ROA	Return on assets
ROE	Return on equity
CAPM	Capital assets pricing model
FCFF	Free cash flow
WACC	Weighted average cost of capital
PV	Present value
NWC	Net working capital
EBIT	Earnings before interest and tax
EAT	Earnings after tax
YTM	Yield to maturity
OLS	Ordinary least square
GDP	Gross domestic product
CPI	Consumer price index
INC	Income
INV	Investment
DEP	Depreciation

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Ostrava dated 12. 04. 2016

Li Peng

Li Peng

List of Annexes

Annex 1

Income statement of BMW Group from 2005 to 2014

Million euro	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Revenue	46656	48999	56018	53197	50681	60477.00	68821.00	76848.00	76059.00	80401.00
Cost of sales	(35992.00)	(37660.00)	(43832.00)	(47148.00)	(45356.00)	(49562.00)	(54276.00)	(61354.00)	(60791.00)	(63396.00)
Gross profit	**10664.00**	**11339.00**	**12186.00**	**6049.00**	**5325.00**	**10915.00**	**14545.00**	**15494.00**	**15268.00**	**17005.00**
Selling and administrative expense	-7226	(7516.00)	(8174.00)	(5369.00)	(5040.00)	(5529.00)	(6177.00)	(7007.00)	(7257.00)	(7892.00)
Other operating income	355	744	730	1428	808	766.00	782.00	829.00	842.00	877.00
Other operating expenses		(517.00)	(530.00)	(1187.00)	(804.00)	(1058.00)	(1132.00)	(1016.00)	(875.00)	(872.00)
Profit/Loss before financialresult (EBIT)	**3793.00**	**4050.00**	**4212.00**	**921.00**	**289.00**	**5094.00**	**8018.00**	**8300.00**	**7978.00**	**9118.00**
Result from equity accounted investments	14	(25.00)	11	26	36	98.00	162.00	271.00	407.00	655.00
Interest and similar income		-	-	685	856	685.00	763.00	753.00	183.00	200.00
Interest and similar expenses		-	-	(930.00)	(1014.00)	(966.00)	(943.00)	(913.00)	(469.00)	(519.00)
Other financial result	-520	99	(350.00)	(351.00)	246	(75.00)	(617.00)	(592.00)	(206.00)	(747.00)
Financial result	(506.00)	74.00	(339.00)	(570.00)	124.00	(258.00)	(635.00)	(481.00)	(85.00)	(411.00)
Profit/Loss before tax (EBT)	**3287.00**	**4124.00**	**3873.00**	**351.00**	**413.00**	**4836.00**	**7383.00**	**7819.00**	**7893.00**	**8707.00**
Income tax	(1048.00)	(1250.00)	(739.00)	(21.00)	(203.00)	(1602.00)	(2476.00)	(2697.00)	(2564.00)	(2890.00)
Net profit/loss (EAT)	**2239.00**	**2874.00**	**3134.00**	**330.00**	**210.00**	**3234.00**	**4907.00**	**5122.00**	**5329.00**	**5817.00**

Annex 2 (1/2)

Balance sheet of BMW Group from 2005 to 2014

€million	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Intangible assets	4593	5312	5670	5641	5379	5031.00	5238.00	5207.00	6179.00	6499.00
Property, plant and equipment	11087	11285	11108	11292	11385	11427.00	11685.00	13341.00	15168.00	17182.00
Leased products	11375	13642	17013	19524	17973	19088.00	23112.00	24468.00	25914.00	30165.00
Investments accounted for using the equity method	94	60	63	111	137	212.00	302.00	514.00	638.00	1088.00
Other investments	1178	401	209	322	232	177.00	561.00	548.00	553.00	408.00
Receivables from sales financing	17202	17865	20248	22192	23478	27126.00	29331.00	32309.00	32616.00	37438.00
Financial assets	642	816	1173	1808	1519	1867.00	1702.00	2148.00	2593.00	2024.00
Deferred tax	772	755	720	866	1266	1393.00	1926.00	2001.00	1620.00	2061.00
Other assets	613	378	415	660	640	692.00	568.00	800.00	912.00	1094.00
Non-current assets	**47556.00**	**50514.00**	**56619.00**	**62416.00**	**62009.00**	**67013.00**	**74425.00**	**81336.00**	**86193.00**	**97959.00**
Inventories	6527	6794	7349	7290	6555	7766.00	9638.00	9725.00	9595.00	11089.00
Trade recevable	2135	2258	2672	2305	1857	2329.00	3286.00	2543.00	2449.00	2153.00
Receivables from sales financing	11851	12503	13996	15871	17116	18239.00	20014.00	20605.00	21501.00	23586.00
Financial assets	2654	3134	3622	3306	3215	3262.00	3751.00	4612.00	5559.00	5384.00
Current tax	267	246	237	602	950	1166.00	1194.00	966.00	1151.00	1906.00
Other assets	1955	2272	2109	1842	2484	2957.00	3345.00	3648.00	4258.00	5038.00
Cash and cash equivalents	1621	1336	2393	7454	7767	7432.00	7776.00	8370.00	7671.00	7688.00
Assets held for sale								45.00		
Current assets	**27010.00**	**28543.00**	**32378.00**	**38670.00**	**39944.00**	**43151.00**	**49004.00**	**50514.00**	**52184.00**	**56844.00**
Total assets	**74566.00**	**79057.00**	**88997.00**	**101086.00**	**101953.00**	**110164.00**	**123429.00**	**131850.00**	**138377.00**	**154803.00**

Annex 2 (2/2)

Subscribed capital	674	654	654	654	655	655.00	655.00	656.00	656.00	656.00
Capital reserves	1971	1911	1911	1911	1921	1939.00	1955.00	1973.00	1990.00	2005.00
Revenue reserves	16351	18121	20789	20419	20426	22492.00	26102.00	28340.00	33122.00	35621.00
Accumulated other equity	(1517.00)	(1560.00)	-1621	-2709	-3100	(1182.00)	(1674.00)	(674.00)	(356.00)	(1062.00)
Treasure shares	(506.00)			(10.00)						
Equity attributable to shareholders of BMW AG						23904.00	27038.00	30295.00	35412.00	37220.00
Minority interest		4	11	8	13	26.00	65.00	107.00	188.00	217.00
Equity	**16973.00**	**19130.00**	**21744.00**	**20273.00**	**19915.00**	**23930.00**	**27103.00**	**30402.00**	**35600.00**	**37437.00**
Pension Provisions	5255	5017	4627	3314	2972	1563.00	2183.00	3965.00	2303.00	4604.00
Other provisions	3243	2865	2676	2757	2706	2721.00	3149.00	3513.00	3828.00	4268.00
Deferred tax	2522	2758	2714	2757	2769	3400.00	3273.00	3040.00	2459.00	1974.00
Financial liabilities	16830	18800	21428	30497	34391	35833.00	37597.00	39095.00	39450.00	43167.00
Other liabilities	1659	1932	2024	2201	2281	2583.00	2911.00	3404.00	3603.00	4275.00
Non-current provisions and liabilities	**29509.00**	**31372.00**	**33469.00**	**41526.00**	**45119.00**	**46100.00**	**49113.00**	**53017.00**	**51643.00**	**58288.00**
Other provisions	2663	2671	2826	2125	2058	2826.00	3104.00	3282.00	3412.00	4522.00
Current tax	462	567	808	633	836	1198.00	1363.00	1482.00	2319.00	1590.00
Financial liabilities	17838	17656	22493	29887	26934	26520.00	30380.00	30412.00	30854.00	37482.00
Trade payables	3544	3737	3551	2562	3122	4351.00	5340.00	6433.00	7485.00	7709.00
Other liabilities	3577	3924	4106	4080	3969	5239.00	7026.00	6792.00	7064.00	7775.00
Liabilities in conjunction with assets held for sale								30.00		
Current provisions and liabilities	**28084.00**	**28555.00**	**33784.00**	**39287.00**	**36919.00**	**40134.00**	**47213.00**	**48431.00**	**51134.00**	**59078.00**
Total equity and liabilities	**74566.00**	**79057.00**	**88997.00**	**101086.00**	**101953.00**	**110164.00**	**123429.00**	**131850.00**	**138377.00**	**154803.00**

Annex 3 (1/2)

Annex3: Independent variables for regression analysis.

Year	GDP			CPI			Disposable personal income per capital		
	China	USA	Germany	China	USA	Germany	China（CNY)	USA（dollars）	Germany（EUR)
2005	1941.75	12274.9	2815.47	86.57	195.30	92.71	9421.60	35888	21407
2006	2268.59	13093.7	2857.63	87.84	201.60	93.11	10493.00	36127	22092
2007	2729.78	13855.9	2998.62	92.02	207.30	95.31	11759.50	39804	22836
2008	3523.09	14477.6	3435.68	97.45	215.30	98.31	13785.80	38873	23122
2009	4558.43	14718.6	3746.92	96.78	214.54	98.01	15780.76	39379	22438
2010	5059.42	14418.7	3412.98	100.00	218.06	100.21	17174.65	40144	23981
2011	6039.66	14964.4	3412.21	105.47	224.94	102.31	19109.44	42332	25052
2012	7492.43	15517.9	3751.88	108.22	229.59	104.11	21809.78	44200	25859
2013	8461.62	16163.2	3533.24	111.07	232.96	105.51	24564.72	44165	25897
2014	9490.6	16768.1	3730.26	113.78	236.74	116.41	26955.10	44129	28976

Annex 3 (2/2)

Year	Exchange rate		Steel price (Euro/metric ton)	Oil price (Euro/Barrel)	Car registration（thousand）			Employed persons			Growth rate GDP of in Germany
	EUR VS CNY	EUR VS USD			USA	GERMANY	China	China (tense of thousand)	Germany（thousand）	USA (million)	
2005	10.332	0.796	502.403	1.250	644.700	281.700	345.500	74647	38326.00	117.02	0.007
2006	10.008	0.797	479.129	1.450	639.333	292.583	442.333	74978	39635.00	119.69	0.037
2007	10.418	0.731	401.871	1.498	625.750	261.667	547.750	75321	40325.00	121.09	0.033
2008	10.224	0.684	606.783	1.643	558.000	259.083	576.583	75564	40856.00	120.03	0.011
2009	9.478	0.720	495.903	1.184	436.917	323.000	842.833	75828	40892.00	112.63	-0.056
2010	8.929	0.755	541.292	1.578	469.342	243.333	1155.250	76105	41020.00	111.71	0.041
2011	8.893	0.759	553.046	1.612	473.125	245.500	1174.583	76420	41577.00	112.56	0.036
2012	8.874	0.759	562.305	1.648	481.408	248.000	1173.083	76704	42060.00	114.81	0.004
2013	8.878	0.757	568.471	1.686	488.742	250.750	1181.667	76977	42328.00	116.31	0.001
2014	8.923	0.752	570.348	1.731	494.075	251.167	1186.000	77253	42703.00	117.26	0.016